THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE IMPORTANCE OF THE INTERNAL-COMBUSTION ENGINE.

TEN years or more ago, it was a common saying that the prime mover of the future was the large gas engine. But the steam turbine, more and more aggressively asserting its claims, gave a new lease of life to the threatened steam plant, and deferred for many years the triumph of its younger rival.

However, "Youth will be served," in this as in other branches of human activity and evolution, and the internal-combustion engine is once more pressing hard upon the defences of its mighty adversary, eager and able to seize the slightest opening for attack, and to turn it to good account.

In some positions, indeed, the gas engine has already for some years firmly established itself—in all places where a cheap supply of gas is available as a by-product of other industrial operations—and there it is almost invariably found acting in partnership with the electrical generator, the sole exception, broadly speaking, being the use of gas power for driving blowers in ironworks. From this cause has resulted the development of the largest electric motors ever built for the purpose of driving steel rolling mills, and the simultaneous extension of electric motive power throughout all up-to-date iron and steel works, and many other factories situated within range of the supply of cheap power thus obtained.

It is true that the domain of public electricity supply is still almost wholly under the sway of the steam plant, not one large undertaking in this country being driven by gas from producers, but there are many private installations in works where the load is steady over long periods—that is, where the load factor is high; under these conditions the gas plant is at its best, as capital charges become of minor importance, and economy of fuel is a paramount consideration. It can no longer be alleged that bituminous coal cannot be gasified on a large scale and successfully employed in gas engines, and therefore the progress of the gas plant in this field largely depends upon the reduction in cost of the engine. In the hands of British designers, material improvements have been effected in the construction of the large engines originally developed on the Continent, as will be gathered from our later pages, and it is not unreasonable to anticipate that at no distant date the gas-driven plant will further invade the territory at present dominated by steam; it has indeed for some years already been a moot question whether it would not be of advantage to install gas plant for the steady load and steam turbines for the peaks.

Latterly a new factor has attained prominence—the crude-oil engine invented by Dr. Diesel—and being made in continually larger sizes, seems destined to win a large share of favour; being unencumbered with a producer and cleaning plant, the Diesel engine is in a still better position to com-

pete with steam plant in electricity works, especially for outputs below the economical limit of the steam turbine, and the wide adoption of the Diesel engine for other purposes tends to hasten its evolution and improvement. Dr. Diesel, it will be noted, regards it as "perfect"; but as even he is unable to decide whether the four-cycle or the two-cycle system is the better, and keeps an open mind on the subject of horizontal *versus* vertical engines, it would appear that his views of perfection are somewhat broad.

Between these two extremes—the waste-gas engine and the crude-oil engine—there is an amazing variety of intermediate types, the number and diversity of which bear witness to the vitality and open-mindedness of British engineering. The vertical high-speed gas engine, for powers up to about 500 H.P., may be claimed as an almost essentially British product in the first instance, and has been developed in the face of many difficulties to a high degree of perfection.

Of the paraffin oil engine, enormous numbers have been built, and the development of the motor-car industry has brought the petrol engine into the electrical field; with the simultaneous introduction of the metallic-filament lamp, the problem of country house lighting has been satisfactorily solved by the combination, and the sphere of the electrical contractor has been greatly extended.

Reviewing the whole situation, it is evident that extraordinary progress has been made during the past decade, and one is led to wonder what will happen during the next few years. That finality is far from attainment is certain: in view of the continuous rivalry between the four-cycle and the two-cycle systems, and the vertical and horizontal types of engine; the many modifications of the Diesel system which have been introduced; the possibility of a gas turbine being developed, and the resurrection of the proposal to generate electricity at the pit's mouth with the aid of gas engines and transmit it to all parts of the country (thus finally solving the smoke abatement problem)—it cannot be doubted that there is abundant scope for invention and evolution, and that ten years hence practice in connection with internal-combustion engines will have undergone great changes.

However, for the moment we must concern ourselves rather with what is than with what will be; and therefore we have thought it opportune to collect a large number of representative examples of practice in all the branches of the industry to which we have referred, and to place them before our readers in the hope that they will be found instructive, useful, or suggestive, according to individual wants and aims, but interesting, we trust, to all engaged in or connected with the electrical industry.

PEAT FUEL.

The discussion of Mr. Tomlinson's paper in Dublin was of high value. In the first place, the speakers kept strictly to the subject, which cannot be said of discussions in general, and secondly, all those who spoke for other than complimentary purposes seemed to have read the paper carefully beforehand—a precaution which has so much to recommend it that its constant omission is a matter for wonder.

The audience obtained much assistance from the admirable speeches of Messrs. Carter and Turnbull, representing respectively Messrs. Crossley Bros. and the Power Gas Corporation, the two firms which have done most to advance the practical use of peat upon economical lines. The representatives of both firms are to be congratulated upon the strictly legitimate use of a very tempting opportunity for advertisement and odious comparisons.

We believe that a syndicate has spent a large sum of money upon experiments on a bog in Dumfries, which involved the use of a good deal of machinery, but nothing was said of the results at this meeting, so it would not be surprising to hear that in this case, as in so many others, the bog has won again. If that should be so, Mr. Tomlinson's theory will receive further support, and it might pay these experimenters even now to try it.

The record of the old Dutchmen's work may be said to have given birth to this theory that Nature, aided slightly by man, will give us peat in large quantities dry enough to use in gas-producers; and it was from modern Dutchmen's industry that Mr. Carter drew the most helpful facts. In spite of severe competition with cheap Welsh anthracite, and cheaper Belgian semi-bituminous coal, peat is a commercial product in Holland to-day, and that is due to the simple methods of getting it. Moreover, experience has proved that there is an almost negligible difference between the results obtained from peat with 34 per cent., and 62 per cent. of water, while the gas is as good as that from the best Welsh anthracite. In fact, peat is an almost ideal fuel for use in a producer, for it does not clinker, and leaves but little ash, and the grate is kept clean. A centrifugal extractor deals with the tarry matter satisfactorily.

Critics of the theory of drying peat *in situ* may ask, with a show of reason, what is to prevent the winter's rain undoing all the work of the summer's sun, even though the mass be drained in the manner proposed, in which event the peat harvest would be confined, as at present, to the short summer months; but the Dutch have proved that a stack of peat will emerge from winter with only 40 per cent., or thereabout, of water, and any Irish or Scotch peasant, whose only fuel is peat, will point to his stacks in evidence of the fact that summer-dried peat, which has not been protected from excessively humid winter weather, does not take up much more water.

We have advanced much nearer the utilisation of peat upon a very large scale than most people imagine, and the sooner the professional men who have an intimate knowledge, or are able to absorb a knowledge, of the facts, start in to educate the laymen who have the opportunity and the means to turn the bogs into gold and smiling pastures, the better it will be for the country at large.

We know now that peat is an ideal fuel, and that engines of any size can be run with the gas it gives off. We know that the products of peat, other than fuel gas, are as valuable as the products of anthracite, and the method of getting them is an old story. What we do not know is the simplest part of the whole affair; it is the way to get peat into the producer at a cost which will allow a profit to be made out of the sale of the peat products—chemicals and power. That is what we do not know, say for Ireland or Scotland, out of practical experience upon a sufficient scale; but now we are able to guess it more nearly by the light of the

fire which Mr. Tomlinson has struck out of the 18th-century Dutchmen and Mr. McMeadows.

Mr. Turnbull says that his company has solved even the last problem, as instanced by the important peat recovery and power plants at Osnabrück (Hanover) and Orentano (Italy), and there is no reason to suppose that these installations are not quite satisfactory; but they cannot be taken, and Mr. Turnbull did not suggest that they should be taken, as sure guides to success in the Irish bogs.

But what a little thing it is that stands between Ireland and fortune!—£10,000 spread over five years to prove whether or not a bog can be made to contain only 50 per cent. of water by drainage and evaporation.

Not Ireland only stands to win heavily with any stake that is thrown, for England and Scotland possess large peat deposits in parts remote from coal, and the nation is waking up to the belief that the world was not made for the coal miner alone. The price of coal will stay at higher rates than before the strike until the owners and the distributors have recouped themselves for their enormous losses from the pockets of the consumers, and after that the rates will be as much higher than the previous normal as the wages bill is above the old wages bill. Therefore, we shall all keep our eyes turned to the quarters from which relief may be expected, and the peat fuel problem ought to get such a chance of solution as it has never had before.

Mr. Tomlinson's investigations, and the discussion of his last paper, have cleared a broad straight road to success; but let us be quite sure that we have all got out of the jungle of previous failures to the point from which we can see that road clearly. The engine is ready, the producer is ready, and the recovery plant is ready. The peat is waiting in untold quantity to be put into the producer at a price which will allow a net profit to be made upon the manufacturing processes which are to follow, and money will pour in directly the peat is ready at the price. Mr. Tomlinson says that this price is to be not more than 4s. He may be right, or he may be wrong, and nobody can say until what we have called the grand experiment has been made. If 4s. is not exceeded the bog can be worked at a profit for sulphate of ammonia alone, and it is that fact which gives us so much more hope for peat than ever before, and leads us to lay down the following sequence of events for the guidance of those who would see clearly down the broad road.

First, then, comes the drainage of a selected bog—say the Bog of Allen. When this is proved feasible, but not a moment earlier, is to be put down a recovery plant upon a large scale.

When this is working at a profit, but not a moment earlier, may be put down the generating station, upon as large a scale as the probable demand requires; and, as the date of completion of this station might be 5 or even 10 years after the first drain was cut, there would be ample time in which to canvass for consumers of electricity.

A scheme properly thought out on those lines will be much more likely to command success than the scheme to which we are so unhappily accustomed, involving usually the immediate expenditure of huge capital sums upon machinery and plant for cutting and drying the peat, for gasifying it and producing electricity, and for transmitting the electricity over large areas of desolate country in search of consumers.

ELECTRIC IGNITION IN INTERNAL-COMBUSTION ENGINES.

The Respective Claims of the High and Low-Tension Systems.

By JOHN S. LEESE.

Each of the above-mentioned systems of electrical ignition includes amongst its partisans those who look with unqualified disfavour upon the other system—the one, that is to say, which does not meet with their personal approval. That each system has its drawbacks is an undeniable and freely admitted fact amongst tolerant designers and users. The blind adherence to one or other system which one sometimes comes across is usually the result of either a long experience and deep knowledge of that system, coupled with a comparative ignorance of the other, or else early failures with the discredited system.

Internal-combustion engines may be conveniently divided into four classes for the purpose of discussing ignition systems. These are:—

1. Low-speed horizontal gas engines.
2. High-speed vertical gas engines.
3. Low-speed horizontal oil engines.
4. High-speed vertical oil engines, including automobile and similar volatile spirit engines.

Considering the advantages of high and low-tension ignition for the first case, practice is all in favour of the low-tension magneto system for these engines, which are usually applied to more or less steady loads and run at a constant and comparatively low speed. The constancy of the load and speed renders the alteration of the timing of the ignition during running hours a matter of but slight importance; whilst the temporary retardation of the spark for starting-up purposes may easily be accomplished with the low-tension system. The moving parts are comparatively immune from wear and consequent noise owing to the low speed. The system, consisting of low-tension magneto, tappets and sparking plug, is quite separate from the other functions of the engine, and needs practically no attention, the only obvious necessity being to keep the plug electrodes in good condition as regards clean contact, so as to ensure a good spark. This duty can hardly be called troublesome. Oscillating armatures subject the magneto machine to less wear than rotary ones, and altogether the system may be regarded as one of the most reliable parts of the whole power unit. The comparatively low compression of low-speed engines renders the low-tension current eminently suitable for the work, whilst its application reduces the necessity for extreme care of the insulated cables. The spark is just as intense at starting-up speed as it is at normal speed, and thus, other things being equal, easy starting is assured.

The application of high-tension ignition, either in the form of the high-tension magneto or battery and coil, to this class of work has not been altogether neglected, but it has made very little progress. The advantages claimed for it are quietness and ease of control. The former advantage is, however, somewhat discounted by the fact that, as low-speed engines are, as a rule, comparatively noisy in general working, the extra clicking due to the low-tension tappets is not worth considering. The second advantage named is not generally particularly desired in this type of engine, as before noted. Whereas battery and coil systems give as good sparks at starting up as when running at full speed, high-tension magnetos cannot claim this advantage, as the intensity of the spark increases with the armature speed. The sparking points of high-tension plugs require to be kept at the proper distance apart, or else trouble will ensue, but low-tension plugs, so long as they make and break, may be relied upon for constant performance.

In high-speed vertical gas-engine work the noise per cylinder is generally reduced to a minimum, and the addition of four sets of tappets and low-tension plugs would increase it unduly. Also the class of work to which these engines are generally put often makes the facility of timing adjustment whilst running a great advantage. The high compression of these engines and the resultant high explosion pressures tend to cause leaks past the movable electrodes of

the low-tension plugs, whilst the wear on the moving parts of the system generally is necessarily more rapid than at the lower speeds considered above. Unequal wear in the tappets and plugs of each cylinder causes unequal spark timing, and this fault is more difficult to correct in low than in high-tension systems. Battery and coil ignition does not possess the disadvantage of high-tension magneto ignition regarding poor sparking at low speeds, and is, therefore, often fitted as a supplement to the latter for starting-up and stand-by purposes. One sometimes sees battery and coil systems fitted without a magneto, or with a small recharging dynamo in continuous operation, driven by the engine. If conveniences are at hand to render battery recharging easy, this system saves in first cost over the high-tension magneto, and, if well cared for, will be found to be at least as satisfactory.

The class of fuel and consequent amount of dirt in the cylinder has considerable bearing upon the best type of ignition to use upon those low-speed horizontal oil engines which use electric ignition. Taking all things into consideration, low-tension oscillating-armature magnetos appear to be the best, on account of the reduced likelihood of the deposit, which occurs on the constantly making and breaking surfaces of the electrodes, interfering with the passage of the spark. With high-tension systems, the jump-spark plugs would soon be likely to become bridged over with carbon, causing short-circuiting. Most of the other arguments in favour of the low-tension system, which were advanced in referring to class No. 1, may be used again in application to horizontal low-speed oil engines.

The last class, high-speed oil and automobile engines, are practically all favourable to high-tension ignition, except in the uncommon case of a high-speed vertical engine running on heavy oil fuel. Reduction of noise is one of the chief assets of high-tension systems, whilst the system certainly needs less attention than ever when applied to high-speed spirit engines; indeed, it is this application that it is best adapted for. It may be applied as battery and coil, or as magneto ignition, although these two are often both fitted and made supplementary, one to the other. In automobile work neatness counts for a lot, and the absence of moving parts, such as tappets, is much appreciated by the user. This is a field in which the high-tension magneto reigns supreme. For boat engines, heavy commercial motors and other special cases, the low-tension magneto may be advantageously used, if, as is often claimed, it is made more foolproof than high-tension systems, but the control of the low-tension timing is too complicated to commend it for very general use.

In conclusion, when selecting an ignition for an engine, the relative advantages of each type and system must be thoroughly investigated with special reference to the case in hand, regarding the nature of the engine, fuel, work to be done, attendance and general facilities, and neither system should be condemned outright for any class of work, as is too often done by the extremists mentioned in the first paragraph.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Colonial References.

As the article published in a recent number of the Electrical Review under the heading of "Colonial References," by "Colonial," directly concerned myself, needless to say I started to read it with great interest; before I had finished the article, however, the temperature of my blood had almost reached boiling point. I turned the page back again to read the Editors' note, and when I came to the words "young engineer," I began to reproach myself for so losing my temper over what was only an ebullition of youth.

Now, if "Colonial" had altered the heading of his article to South African References, and signed himself "South Africa," I should not have minded, but to include all the Colonies as he does, is a great mistake, and I for one must defend the colony with which I am connected.

About the middle of the article "Colonial" says: "It must be admitted that many men who, on account of their poor qualifications, could never get a good position in England, go abroad and manage to get what they cannot get at home." Was this the reason why "Colonial" left the "Mother Isle"? and did he not get what he expected when he went abroad? and is this the reason why he writes an article which will, far from raising the status of the electrical profession in the Colonies, tend to lower it in the eyes of home engineers?

With regard to the up-to-dateness of Colonial engineers and their works, does "Colonial" ever read the "Contract" columns of the Review? If he did, he would see that electrical plant of the most modern type is being tendered and contracted for weekly by the Colonies; and, as a general rule, when this plant arrives in the Colony it is erected and tested by the staff there. In England, on the other hand, an erector is sent out with the plant, and usually some official from the firm comes to "start up." These men know, and are accustomed to, all the peculiarities of their firms' products, and so can instruct the engineer-in-charge as to the best way of running them. The Colonial engineer and his staff must find out all these things for themselves, and in this way gain much useful and practical experience.

And now to come to statistics. The plant I am in charge of is one of the smallest, if not the smallest, in the Colonies, the capacity of the plant being just over 500 kw. Some of the plant is modern, but most of it has been running for the last 16 years. The following are some of our figures:—

Average coal per kw.-hour, 4 lb.

Lb. of water evaporated per lb. of coal, 10 lb.

Price in pence of coal per kw.-hour generated (coal at 26s. per ton), ·68d.

Price in pence of oil, waste and engine room stores per kw.-hour generated, ·048d.

As to Colonial log books being "funny," I can scarcely agree with "Colonial," and perhaps he will be interested to know some of the things which we do out here. Once a shift the following readings are taken and logged: Specific gravity of boiler and condenser discharges, temperatures of superheaters and feed water, coal per unit, water per pound of coal, engine and boiler hours run, maximum load and power factor. In addition to these, there are installed recording steam and vacuum gauges, recording wattmeters and voltmeters. Engines are indicated every six months, and cards are properly filled in and kept.

In conclusion, I would ask "Colonial" to give details of his training and experience, and let other people judge whether he is competent or not to criticise Colonial engineers and their doings. Hoping I have not taken up too much of your valuable space,

Near East.

With reference to the article by "Colonial" in your issue of March 29th, I have no doubt that South African engineers will accept your invitation to communicate their side of the question, but as the article refers to Colonial engineers generally, I, for one, wish to enter a protest against the publication of such vague statements in your widely-read and influential journal, which being read by persons in authority, are likely to prejudice a Colonial engineer's prospects of obtaining a home appointment.

I further question the right of "Colonial" to include the colonies in his remarks; apparently he has no experience of any colony other than South Africa, and, in my opinion, a limited amount of that.

A belief already exists amongst some managers of "Home electricity concerns" that the Colonial engineer is out of date, and I have suffered from this erroneous idea.

Some few years ago I was an applicant for the post of shift engineer in a large power station, and my application was backed by an engineer prominently connected with the undertaking; the manager, however, would not recommend my application, stating as his reason for refusing to do so "that having been so long in the Colonies (2½ years) I should be out of date with regard to English practice." Had I been in England in an out-of-the-way provincial town I

have every reason to believe that I would have secured the appointment.

The question then is :—"What advantages have assistant engineers in a provincial town over their colleagues in the Colonies"? and how can they keep themselves more up to date? The former can only keep up-to-date by reading the technical journals and perhaps an occasional visit to some neighbouring engineering works; their salaries are usually insufficient to provide the latest text-books or to allow of a visit to the engineering exhibitions; moreover, the vacation leave is restricted to two weeks at the most, and as a general rule they do not make a 'busman's holiday of it.

Now, take the case of the Colonial engineer; the arrival of the technical papers is looked forward to with great interest, and they are perused from cover to cover; the technical works that concern the supply of electricity are usually supplied by the proprietors of the undertaking, and are read with avidity by the staff, who have perhaps less diversion for their leisure hours than home colleagues.

In the undertaking with which I am connected, the engineers are allowed three months' holiday every two years, and personally I spend most of that time in England and take the opportunity to visit all the electricity works that I possibly can, and any engineering exhibition in progress at the time. It is, therefore, obvious that as regards junior engineers, the Colonial should be equally up-to-date with the British.

Chief engineers at home have more opportunities of keeping abreast of the times, and to them the above remarks do not apply, but, at the same time, a chief engineer in the Colonies has to be a capable and relf-reliant man, and a man that can erect and maintain the whole of the plant without the aid of the manufacturers, even when handicapped with very indifferent labour. No home engineer can properly appreciate the latter part of the above sentence. In many Colonial stations, when a breakdown occurs, the complete repair is undertaken by the staff. In England, on the contrary, it is usually much quicker and cheaper to order spare parts from the makers, and although this is, perhaps, beneficial to the undertakings, it is not so to the engineers, and does not improve their practical experience.

It cannot be denied that there are Colonial undertakings which are not making normal progress; the cause of this is usually "indifference and neglect on the part of the powers that be," and cannot be ascribed to incompetence on the part of the chief or his staff. Local politics also have quite an influence on the undertakings, usually, as at home, acting as a drag; these obstacles to progress will be overcome by the benign influence of time and the education of the population in matters electrical.

Justice.

Tests of Metal-Filament Lamps.

I have read with interest Mr. Willcox's letter on lamp testing in your last issue. The efficiency of the tungsten lamp has not yet been standardised. One maker aims to produce lamps at 1·25, and another at 1·50 watts per C.P. It appears to me incorrect to test either product, except at about the maker's standard efficiency. To test at an efficiency at which the maker does not aim to work appears to me unpractical.

The lamps for recent tests were obtained direct from the makers, who were informed for what purpose the lamps were required. Presumably the makers all sent out new lamps and selected them to run on normal voltage at that efficiency which they considered most suitable. This arrangement appears to me to be fairer to the makers than starting all lamps at one efficiency, irrespective of what the makers may individually desire.

A test carried out on these lines helps to buck up the makers to renewed efforts, sets a fresh standard to be surpassed for each year, and is useful as an indication of the general progress made year by year.

I have often carried out life tests as Mr. Willcox suggests, disregarding the marked voltage and starting the lamps at one common efficiency. Provided that mean spherical and not mean horizontal candle-power is measured, such a test forms a fairly good means of comparison of the wearing quality of filaments, but it is not, strictly speaking, a test of lamps.

The objection to buying lamps in the open market is that the samples would be of various ages—new-laid, fresh and otherwise. Now both the resistance and emissivity of a tungsten filament undergo marked change during the first six or nine months of its existence, even if the lamp is kept idle all the time. The result would be that the various makes would not start fair.

In conclusion, I would like to thank Mr. Willcox for his criticism. I should like to receive, either publicly or privately, such a candid criticism from every subscriber to the lamp test report.

Lancelot W. Wild.

Westminster, *April 12th*, 1912.

Legal.—Gott v. Veritys, Ltd.

In the report appearing in your issue of the 5th inst. of the hearing of an action by Arthur Edgar Gott against Veritys, Ltd., of Aston, you state that the Judge said he had come to the conclusion that there was a breach of agreement with regard to one of the patents.

We should be obliged if you would permit us to correct that statement, the fact being that the judgment of the Court was merely upon the construction of the agreement between the parties, and it was to the effect that if our clients (Veritys, Ltd.) had "wilfully" done certain things, then a breach of the agreement had been committed, but the question whether they had wilfully done these things was referred to an Official Referee, who will, of course, hear the evidence of both sides before arriving at a decision, and the costs of the action are to abide the result of such Referee's report.

Ansell & Ashford,
Solicitors for the Defendants.

Birmingham, *April 11th*, 1912.

[Our report was derived from the *Southall and Norwood Gazette*, as stated in our issue of April 5th.—Eds. E.R.]

Fraudulent Tests.

The publication of the article on this subject in your issues of the 5th and 12th inst. cannot be allowed to pass without strong protest; it is misleading, and with those having little knowledge of the subject treated, it must create an absolutely false impression; it, in fact, accuses directly, or by suggestion, all and sundry firms, of deliberate and systematic fraud in connection with the work done on their test-beds, and, incidentally, grossly libels inspecting engineers in general, and Admiralty overseers in particular.

For some 14 or more years I have been directly engaged in the testing departments of several of the largest firms manufacturing electrical plant in this country, and have attended many "official trials" at engine makers' works and afterwards on site. I have met a large number of Admiralty officials, from those coming direct from Whitehall down to the young assistant overseer (usually first trained as a dockyard apprentice) fresh to his job, and I cannot call to mind a single one whom I would dare have the effrontery to attempt to befool by most of the obviously crude and certain-to-be-found-out, so-called, "tricks of the test-bed" mentioned by the writer of the article. My experience, Sir, is that, on the whole, the Admiralty overseer knows his job pretty well, and does his work concientiously and well, for it must not be forgotten that he has always the fear before his eyes that the plant he passes will have to perform equally well later on, and woe betide him should there be any great discrepancy between the results of the two tests.

The charges made against firms of such standing as to be on the Admiralty list can scarcely require any refutation. Considered from the point of simple policy, does anyone believe it to be worth the while of a large firm to run the risk of attempting such frauds as are enumerated, when detection means not only removal from the Admiralty but from all Government, India Office, Colonial and other important lists? The news of such detection would travel far and wide, and would not be long in reaching the ears of competing firms who naturally, as a matter of business, would use the information to the disadvantage of the offending firm.

Again, such practices would be bad policy, as in the case of most contracts, as already pointed out, tests have to be repeated, after erection, on site; now it is obviously unwise to rush things through the test and later on to have trouble on site as the alterations, adjustments, or whatever may have to be done in order to bring the plant up to specification, will cost a much larger amount than if carried out at the maker's works.

Yet another proof of the insanity of such methods is that in these days of competition a satisfied customer is a *sine quâ non* for successful business; only those engaged in getting orders know fully how difficult it is not only to obtain new customers but to retain the old ones, or how easily a good customer may be lost.

Your contributor has a very low and perverted view of the testing engineer; it is not only a case of "All men are Liars," but liars all the time. I can assure him that to my knowledge there are many men engaged in this class of work who, if not from a moral point of view, consider their best duty to their employers is to take the *rôle* not of counsel but of judge and to hold the balance between those responsible for design and manufacture (who rightly are always keen on getting the maximum duty from a given piece of plant) and the customer, and who make it their business to see that he gets a satisfactory article; were this not the case a testing department were unnecessary.

I cannot but think that the writer of the article looks out upon life—business life—through grey spectacles, and if engaged in inspecting work I can well imagine him to be a Shylock with no idea of give and take; for to turn the tables for a moment, I have known a consulting engineer insist on a rebate from the price of a large motor-generator, the armature of which had a rise of two or three degrees above that specified, notwithstanding a 3 per cent. higher combined efficiency (quite genuine, Mr. Author!) than guaranteed.

In conclusion, I deny that specially "falsified" instruments and thermometers with fictitious scales, &c., exist in the test departments of responsible firms, and as regards the faking of the tests of combined sets in the manner stated for temperature and regulation, I cannot conceive that any sane engineer would attempt such almost impossible methods; in fact, the article generally gives one the impression, notwithstanding a statement to the contrary, that most of these "fakes," plausible as they may seem, have come from any place other than the test-bed.

Modulus.

Some Thoughts on "Some Thoughts on Publicity."

Because the position of the author of "Some Thoughts on Publicity" on a pinnacle among central station engineers has never been questioned, we must regret that he has published his private opinion and thus loaded the muzzles of the ever-ready opposition with such valuable publicity material.

It may be that he is somewhat rancorous at the loss of dignity to the profession by the introduction into its deliberations of such huckstering topics as "How we diddle them at ———," or "Expedience teaches," but even so a sacrifice of inaction would be more commendable than this "queering of the pitch" and then damnation in a peroration of faint praise.

His philanthropic concern for the purse of the householder who struggles along with two "generals" is praiseworthy but unnecessary. If such a one, before purchasing for his partner a half-guinea flat-iron (which by the way is rather a clean pretty thing and a distinct advance on those 1s. affairs from the Army and Navy Stores), must consider and compare standing charges and running cost per handkerchief or other item, he is admittedly outside the pale of any selling agent, and the sooner the supply engineer fixes a slot meter on his installation the better it will be for the undertaking. There is still a great market for electrical utilities and toys, and if these do not quite come up to the label it is unfair to expect that an infant industry should take the lead in a crusade for the purification of commerce while struggling for existence among unscrupulous competitors. After all, the vacuum cleaner does really *remove* dust, and has that advantage over the *Family Herald devotée*, who merely stirs and scatters it.

There is doubtless a reluctance on the part of manufacturers to raise the wattage of apparatus, and in consequence we have convectors and radiators which compare badly with the coal fire at its best, and kettles, toasters, and egg-boilers, whose time factors do try one's patience, although, again, it is valuable to know that the time is a constant and can be relied upon. With the tendency of supply authorities to reduce the charge for this class of demand to "units at two a penny," manufacturers would do well to double or treble the capacity of heating elements. With this speeding up, increased appreciation would increase sales, prices would drop, the necessity for much deplorable mendacity would disappear, and George Washington might obtain a post on the publicity staff even in competition with Ananias.

There is a real danger of electric homes becoming over-popular. I have in mind a house of £40 annual rental, where the installation, consisting of lighting, oven, and cooking utensils, radiators, hot water circulators, &c., aggregate 17 KW., with a maximum demand of over 5 KW.; the payment to the supply company, with tariffs 3½d. lighting and 1¼d. heating and cooking, is under £10 per annum, and the price has now been reduced to ½d. per unit during the six summer months. An extended imitation of the above in a residential district must not only give the mains engineer to think, but must dispel the justification for enticing and encouraging this class of demand by recklessly foregoing charges on capital, which will inevitably have to be found.

George C. Law.

Electricity Works, Barnes,
April 15th, 1912.

Notes from Canada.

The able and forcible article on page 574 of your current issue has to me been most interesting, for just recently I have been engaged on a duty which, perhaps, is not particularly common in this country, viz., arranging for the lay-out and purchase of the electrical power and lighting equipment for a large Canadian factory requiring some few thousand H.P., and the experience gained in so doing has been of a very instructive nature.

In common with your correspondent, I find that practically all electrical supply and insurance companies' rules, regulations, and requirements, are those originating in U.S.A., and it is here that the would-be purchaser of British material finds himself up against something approximating to a brick wall.

The standard regulations with respect to wiring and accessories are, I find, those of the National Board of Fire Underwriters, and a wonderful code it is. Many unkind things have been said regarding the rules issued by various municipal authorities of this country, but the worst of them —from the contractor's point of view— is streets behind the "National Electrical Code" in specifying all sorts of pettifogging details and requirements. Many of these requirements do not by any means add to the efficacy of the installation, and difficulty is experienced in conforming with the regulations when purchasing standard and high-class articles over here; for, naturally, the Code has been written up to suit the American market.

The installation rules of the Institution of Electrical Engineers are not, I gather, accepted by any supply company or fire insurance company in Canada, at least in the West, and it would seem that, in the interest of the British manufacturer, it is very essential that something effective should be done to form a Canadian Section of the Institution of Electrical Engineers, and efforts made to get the Institution of Electrical Engineers' regulations accepted as the standard, instead of the code previously referred to.

Until this is done, it seems to me there is very little chance of many large orders for cable and accessories coming to this country; for example, it is doubtful if many firms over here can give delivery from stock of, say, a mile of "slow burning" wire, or, alternatively, a mile of "slow burning weather-proof" wire, or again, of, say, a gross of lamp-holders screwed ⅜-in. American pipe thread.

I suppose that over here private individuals cannot do very much towards establishing a Canadian section; most of the work must be done in Canada, but I feel sure that if the idea were suitably placed before Canadian engineers it would

not be long before sufficient response would be made to warrant the establishing of such a section, with doubtless beneficial results to many other than those directly engaged in electrical engineering.

W. H. B.

NATIONAL INSURANCE: WITH SPECIAL REFERENCE TO THE ELECTRICAL INDUSTRY.

By JOS. J. H. STANSFIELD, F.C.I.S.

For months past much has been heard about the National Insurance Act, 1911, from all points of view. Friendly Societies, Trade Unions, doctors, servants and others have expressed their doubts of, or concurrence with, the Act, but perhaps the least has been publicly said or written by the great majority of employers or employed, that is to say, by those who are most vitally affected by its provisions.

Strange as this may appear at first sight, it is not perhaps difficult to account for, because, in addition to the general apathy with which most Bills in the making which affect the social condition of the people are met, the bulk of employers have few officially recognised channels by which their considered views can be made known to our legislators—particularly where a Bill is treated as a so-called non-contentious measure—whilst employés have, so far as they are members of Friendly Societies or Trade Unions, no doubt, made their wishes known through these Societies or Unions, and so far as they are not members have troubled very little about the matter at all.

We are, however, not now concerned with the consideration of the merits of the Act, as whether liked or disliked it is *un fait accompli*, and it must be accepted and made the best of.

The Act is estimated to affect in one way or another about 14 million persons, but it is only proposed in this article to deal with the provisions relating to employers, and particularly those employers who are engaged in the various branches of the electrical industry; but limited as this side of the question is, it is necessary to carefully consider over one-third of its 115 Sections and at least six out of its nine Schedules.

The Act is divided into three parts. Part I (83 Sections and 5 Schedules) dealing with National Health Insurance; Part II (24 Sections and 3 Schedules) with Unemployment insurance; and Part III (8 Sections and 1 Schedule) containing miscellaneous provisions. In considering the matter it will be convenient to take the subjects of national health insurance and unemployment insurance separately.

National Health Insurance.—Insured persons are broadly divided into two classes—employed contributors and voluntary contributors—but as the latter are persons who are not employed within the meaning of that part of the Act which refers to national health insurance, we need not concern ourselves about them except to note that the Act contains provisions (Sec. 6) providing for a change from the voluntary rate to the employed rate of contributions, in which case the employer is concerned with the rate of contributions payable.

It becomes necessary, therefore, to consider who are employed contributors, and a definition of these will be found in Part I of the first schedule, which sets out in full what may be shortly stated, that employed contributors are all persons who are employed in the United Kingdom (excluding the Channel Islands and the Isle of Man) under any contract of service or apprenticeship and under any conditions of employment.

The rates of contributions payable in Great Britain are set out in the second Schedule, and so far as they affect employer and employed are as follows: To be paid by the employer—3d. a week; to be paid by the contributor—men, 4d. a week; women, 3d. a week. Should the employé be 21 or over, and the remuneration does not include board and lodging, the rates payable per week vary as follows if the daily wages do not exceed 2s. 6d.:—

Not exceeding per day.	Paid by employer. For men.	Paid by employer. For women.	Paid by contributor.
1s. 6d.	6d.	5d.	—
1s. 6d. to 2s.	5d.	4d.	1d.
2s. to 2s. 6d.	4d.	3d.	3d.

The rates payable in Ireland are:—To be paid by employer, 2½d. a week; to be paid by the contributor—men, 3d. a week; women, 2d. a week. In the case of employés of 21 or over, under the conditions above referred to, the rates are:—

Not exceeding per day.	Paid by employer. For men.	Paid by employer. For women.	Paid by contributor.
1s. 6d.	4½d.	3½d.	—
1s. 6d. to 2s.	4d.	3d.	½d.
2s. to 2s. 6d.	3½d.	2½d.	2d.

In the case of voluntary contributors, the rates payable by them will vary according to a table to be prepared by the Insurance Commissioners, unless they are below the age of 45 at the date of entry into insurance, and such entry is made within six months after the commencement of the Act, when the rates of contributions will be as above (Sec. 5). Should a voluntary contributor become employed, the rate payable by him as a voluntary contributor will continue to be payable, unless an application is made by him to be treated as an employed contributor (where such an application can be made under the Act), but the contribution payable by the employer will be the same in either case (Sec. 6). Where a voluntary contributor becomes employed, it would appear necessary for the employer to ascertain from the employé what contributions must be deducted on his behalf.

The before-mentioned rates are, however, subject to the following variations:—

1. No contributions are payable by either employer or employed:—
   - (*a*) If the employé is not 16 years of age (Sec. 1 (1)).
   - (*b*) If the employé is 70 years of age or upwards (Sec. 4 (3)).
   - (*c*) If the employé is under a contract of apprenticeship without receiving any money payment (First Schedule, Part I (*a*)).
   - (*d*) If the employé is engaged in other than manual labour at a salary of over £160 per annum (First Schedule, Part II (*g*)).
   - (*e*) Whilst the employed contributor is away on holiday, or otherwise without remuneration, or is in receipt of sickness or disablement benefit (Third Schedule (1)).

2. Contributions are payable by an employer on his own behalf, but not on behalf of the employé:—
   - (*a*) If the employé is 65 years of age or upwards, and under the age of 70 (Secs. 1 (4) and 49).
   - (*b*) If the employé has obtained a certificate exempting him from the liability to be insured under the Act, because (1) he is in receipt of a pension or income of an annual value of £26 or upwards, or (2) he is ordinarily and mainly dependent for his livelihood upon some other person (Sec. 2 (1)).

3. It may be arranged for no contributions to be payable:—
   - (*a*) If the employment is under the Crown or any local or other public authority where the Insurance Commissioners certify that the employés are already as well, or better provided for (First Schedule, Part II (*b*)).
   - (*b*) If the employment is as a clerk or salaried official in the service of a railway or statutory company who are already provided for by a superannuation fund approved by the Commissioners (First Schedule, Part II (*c*)).

4. It may be arranged to reduce the rate of contributions payable by employers and employed if it is the custom to pay wages during periods of disease or disablement, subject to consent of the Insurance Commissioners and the compliance with certain prescribed provisions (Sec. 47).

5. The rates of contributions payable may be varied:—
   - (*a*) By the Insurance Commissioners including persons now excluded by Part II of the First Schedule to the Act. These include amongst others, the persons mentioned under (3) above and clerks and salaried officials, agents, &c. (Sec. 1 (2)) and

(*b*) In the case of employment of a seasonal nature and subject to periodical fluctuation, when the contribution payable by both employers and employed may be increased by a special order of the Commissioners (Sec. 50).

6. The employer may be concerned with a varying rate of contributions so far as the employé is concerned under the following circumstances :—

(*a*) If a voluntary contributor becomes an employed contributor and does not apply to be transferred to the employed rate of contribution (Sec. 6).

(*b*) If an approved society makes a special levy upon its members in consequence of a deficiency in its accounts (Sec. 35). It is not clear from the Act whether this levy should be made upon the society's members direct or through the employer.

(*c*) If upon a valuation by an official valuer under Sec. 36, a compulsory levy is made upon members when the employer may be required to collect such levy by weekly instalments.

All contributions in respect of employed contributors (except of course that portion payable by the Treasury) are to be paid in the first instance by the employer (Sec. 4 (2)), the rules as to payment and recovery of contributions paid on behalf of employed contributors being prescribed at some length in the Third Schedule.

Shortly stated, the provisions of this Schedule are :—

1. One weekly contribution is payable for each week or part of a week.
2. If wages are paid the contributions may be recovered by deduction.
3. The contributions deducted must be for the same period as the wages paid.
4. If the contributions are not deducted they can only be recovered summarily as a civil debt within three months thereafter.
5. The first person employing a contributor in any week is the employer for that week.
6. As to indirect employment.
7. No deduction may be made if the contributor is not paid by wages or other money payment.
8. The employer may not deduct his own contribution from the employé.
9. The employé is a trustee for sums deducted.
10. As to outworkers.
11. A week is from midnight on Sunday to the following Sunday midnight.

Provisions (3) and (4) of the above are important, as it would appear that a contribution cannot be deducted from an employé except for that period for which wages are paid, and if wages are paid in full by mistake the amounts overpaid can only be recovered by an application to the Courts made within three months thereafter.

Various penalties and liabilities affecting the employer are contained in the Act as follows :—

(*a*) An employer shall make good any extra expenditure of a society caused by sickness or epidemic above the average where, upon inquiry, it is held to be due to the condition or the nature of the employment or to any neglect on the part of the employer to observe or enforce any Act affecting health, housing, &c., or any regulations made under such an Act (Sec. 63).

(*b*) A fine not exceeding £10, in addition to any unpaid contribution, is payable in respect of each employed contributor if contributions are not paid or deducted by the employer (Sec. 69).

(*c*) The employé may proceed against an employer if he is deprived of any benefits through the employer not making contributions in respect of him (Sec. 70).

(*d*) Where an insured person appears to be entitled to compensation under the Workmen's Compensation Act, 1906, the Employers' Liability Act, at common law or otherwise, and refuses or neglects to take proceedings, a society or Insurance Committee may take proceedings against the employer to enforce the claim (Sec. 11).

There are several other sections in this part of the Act which may affect employers, the most important being as follows :—

Secs. 25 and 73 makes special provisions for superannuation or other provident funds established at the date of the Act for the benefit of persons employed by one or more employers, and

Sec. 39 provides that such funds may be exempted from pooling arrangements made by societies having less than 5,000 members at the time of a valuation.

Sec. 58 provides for advisory committees being appointed by the Insurance Commissioners, consisting of representatives of associations of employers and others.

Unemployment Insurance.—In order to ascertain whether a workman comes under the unemployment portion of the National Insurance Act, a careful reading of the Sixth Schedule will be necessary; and although the electrical industry is not specifically included in the list of trades which may be shortly described as (1) building, (2) construction of works, (3) shipbuilding, (4) mechanical engineering, (5) ironfounding, (6) construction of vehicles, and (7) sawmilling, it must not be overlooked that under Sec. 107 (2) in determining any question as to whether any trade in which a workman is employed is an insured trade or not, for the purposes of unemployment insurance, regard must be had to the nature of the work in which the workman is engaged rather than to the business of the employer, and it seems clear that the erection of generating stations and sub-stations, and most of the work of equipping them, will, therefore, come under this part of the Act, and it may be that the laying of mains, the construction of street boxes, the erection of overhead mains, and other similar works, bring the electrical industry in most of its branches within its purview.

As in the case of health insurance, contributions are payable by the employer on his own behalf and on behalf of his workmen (Sec. 85), but there are no provisions as to payment and recovery under the unemployment insurance portion of the Act similar to the Third Schedule dealing with health insurance, it being apparently left to the Commissioners to issue these.

These rates of contributions are set out in the Eighth Schedule, and are as follows for the respective periods of employment :—

Period not exceeding.	Age.	Payable by employer.	Payable by workmen.
1 day	16 or over	1d.	1d.
2 days	16 to 18	1d.	1d.
"	18 or over	2d.	2d.
1 week	16 to 18	1d.	1d.
"	18 or over	2½d.	2½d.

The contribution payable may be added to or varied under the following conditions :—

1. By the inclusion with the consent of the employer of
(*a*) Workmen who are employed under the same employer partly in an insured trade and partly not in an insured trade to be treated as if they were wholly employed in an insured trade (Sec. 91 (1) (*a*))
(*b*) Workman employed in a rural district and occasionally occupied in an insured trade (Sec. 97).

2. By the extension of the Unemployment Insurance provisions by an Order of the Board of Trade with the consent of the Treasury (Sec. 103).

3. By an alteration by the Board of Trade of the rate of contributions payable but so as not to treat employer or workmen unequally or to increase the contributions above 1d. each per week.

(*a*) If the unemployment fund is insolvent (Sec. 93 (2)).
(*b*) By septennial revisions if the unemployment fund is insufficient or more than sufficient (Sec. 102).

It should be stated here that the contribution rates may be varied under (*b*) as between trade and trade, and, should this power be exercised, some difficulties may be expected as the l st of insured trades overlap.

The following provisions provide for contributions to be refunded by the Board of Trade to the employer :—

(*a*) If an employer applies within one month after the end of any year, one-third of the contributions of the employer must be refunded in respect of any workman

who has been continually employed through the year, and in respect of whom not less than 45 contributions have been paid (Sec. 94 (1)).

(*b*) If an employer has been systematically working short time, such contribution paid by him for his workmen and himself as may seem just to the Board.

(*c*) If contributions have been made for a person who has been engaged as an insured workman in error (Sec. 100 (2)).

The most important provisions affecting employers not already enumerated are :—

1. Courts of referees for the purposes of the Act must represent employers with an equal number of workmen's representatives and an independent chairman (Sec. 90).
2. Employers may make arrangements with labour exchanges to carry out certain duties under the Act (Sec. 99).
3. As to fines for offences (Sec. 101).

General.—Sec. 110 provides that contributions payable by an employer under the Act are preferential debts within the meaning of the Bankruptcy Act, 1888, and under Sec. 111 the benefits are inalienable.

Under Sec. 112, inspectors have powers of entry and examination in respect of any premises, other than a private dwelling house not being a workshop, where he has reasonable grounds for supposing workmen are employed.

The foregoing deals only with the most important provisions, and, indeed, the Act enters very little into the details of administration, leaving these to the direction of the Insurance Commissioners.

Many points are doubtful, difficulties are already apparent, and more will appear when the Act is put into operation on July 15th next, or such extended date not being later than January 1st, 1913, as the Commissioners may fix.

In the Pensions Act recently passed in France, it is stated that the Book of Industries issued by the Government extends to nearly 900 pages. The National Insurance Act deals with more than the French Act, and it may be anticipated that the various orders and instructions of the respective Commissioners for England, Wales, Scotland and Ireland will be voluminous.

It is clear that for some time to come employers will have to keep up to date with these Orders and Instructions, and the Associations connected with the various industries should be of great assistance in this direction. In this necessary work, no doubt the Institution of Electrical Engineers and the B.E.A.M.A. will take their fair share.

It would appear from a careful reading of the Act that employers will have a good deal of additional work to do in providing for the payment of contributions. An alteration in the ruling of the wages sheets will be necessary in most cases, and an efficient method of checking the issue of stamps, the analysing of contributions, the payment of casuals and gangs and of men working at a distance from the central works, will be required.

In order that workmen may prove continuous employment, or where a workman has lost his card or book, communications with his society or the Post Office will, no doubt, arise, and this additional work will entail additional clerical expense, the cost of which can at present only be conjectured. This article is by no means exhaustive, but it is hoped that it may help somewhat in anticipating the requirements under the Act, particularly so far as it affects employers in the various branches of the electrical industry.

A Steam Turbine Monument.—According to *Power*, the General Electric Co. has re-erected in the centre of a park plot in its grounds at Schenectady, N.Y., the first 5,000-KW. Curtis steam turbine installed in the Fisk Street station of the Commonwealth Edison Co. at Chicago. It is to serve as a memorial to the rapid development of the steam turbine unit applied to central station service. This turbine was installed in the Fisk Street station eight years ago, being put in operation on October 2nd, 1903, and remained in continuous service until May 29th, 1909. It was specified in the contract by President Insull when this unit was replaced that it should be set up as a monument to commemorate the great step in engineering which its installation marked. A bronze tablet detailing its history has been placed on the turbine.

THE TEMPERATURE OF GAS-ENGINE CYLINDERS.

The general impression is that, as the temperature of the gas-engine cylinder increases, so up to a point does the efficiency, but the power developed becomes less. Experiment has shown, says Mr. Batey in an article in *Cassier's Magazine*, that the efficiency increases up to 212° F., a temperature beyond which opposite results are shown. It is easy to understand why the power grows less as the cylinder wall becomes hotter, for the cylinder must heat the incoming charge, and the expansion of this will reduce the quantity entering the cylinder.

The work done depends, says Mr. Batey, upon the difference between the temperature of the entering charge and that of the exhaust gas. He cites an entering temperature of 80° F., and an exhaust temperature of 900° F., the difference being 820°, which is a measure of the work done. We confess ourselves unable to follow this argument, which appears to be reckoning in a sort of reverse fashion, for is not work done by fall of temperature? The charge may enter at 80°, but it speedily acquires, say, a temperature of 2,500°, and it leaves, say, at 900°. The difference is 1,600°, and it is *this* difference that measures the work done. Mr. Batey may be right in his conclusions, but we cannot follow his argument.

But it is easy to agree to the statement that a highly-heated residual exhaust will prevent the entry of a full weight of fresh charge, though even here it must not be overlooked that a cool exhaust spells a greater weight of residual gases, for the weight of gas occupying unit volume varies inversely as the absolute temperature.

The united volume of charge and residuals remains equal, but the weight of the charge will vary. Thus to get as much power with a hot charge as with a cooler charge a bigger cylinder is required. Generally, therefore, says the author, where results are referred to a theoretical compression of 4 to 1, the engine should be designed for a compression ratio of 5 to 1.

Tests by Prof. Hele-Shaw are quoted to show the relation of variation of water temperature to the gas tests. In five tests, as below, the engine ran at speeds varying from 1,086 to 906 R.P.M., where the exit jacket water varied from 77° to 253·4°. In the first three tests the water ran through the jackets. In Nos. 4 and 5 the water was simply allowed to boil off, glycerine being employed in No. 5 to keep up the temperature.

No. test.			Temperature F°. Entry.	Exit.	B.H.P.	Rev.
1	...	...	66·2	77	4·775	1,086
2	...	...	64·4	131	4·47	1,084
3	...	...	64·4	212	3·97	903
4	...	...	212	212	4·07	925
5	...	...	253·4	253·4	3·94	906

It is to be noted that the power per revolution varies but little. It is not always the highest economy that is wanted in daily work. Oftener it is the maximum plant output which is sought, no matter at what cost, and hence, perhaps, the ordinary rule that jackets are best worked at 120° exit temperature.

Of course, in theory it is rank folly to cool the cylinder of a heat engine. But even if it were practicable to work a cylinder without water cooling, this could not be done with present methods of taking in the charge. This simply flows in after the moving piston, and only so much enters as can make its way in. But the charge may be pumped into the cylinder, and is so pumped in, in the case of the Körting engine, which is the modern representative of the Clerk engine. In the Clerk system the charge is forced into the cylinder by a separate pump and at minimum temperature. The cylinder temperature has no effect in controlling or limiting the weight of the entering charge, and the cooling jacket can then be worked at any temperature that may be found best.

The economic advantage of the internal-combustion engine is made the more evident when it is reflected that this economy is secured despite the use of so bad a principle as the water cooling of the working cylinder.

D

THE INTERNATIONAL SMOKE ABATEMENT EXHIBITION AND CONFERENCE.

[BY OUR SPECIAL CORRESPONDENT.]

(*Concluded from page* 576.)

The Conferences on Smoke Abatement, held on Tuesday, Wednesday and Thursday, March 26th, 27th and 28th, attracted influential gatherings of experts and representatives of municipal and local authorities, as well as many foreign visitors. The attendances were not so large as had been expected, doubtless owing to the difficulties created by the coal miners' strike; on the Northern railways of the United Kingdom especially, a very large number of trains had been withdrawn.

It was stated by Mr. Chubb, the very energetic and courteous secretary of the Exhibition and Conference, however, that 71 authorities and societies had sent representatives to the Conference; there were 21 delegates from the London borough councils, over 25 delegates from provincial councils, nine delegates from foreign municipalities, one each from the Governments of Sweden and Holland, and several from America. The attendance at the Conferences therefore made up in weight and influence what it lacked in numbers, and most interesting papers and discussions were heard.

As 28 papers were presented during the three days, it is impossible in this brief report to give any complete summary of the same or of the discussions upon them, and all that can be attempted is a general review of the results attained. The papers and official reports of the discussions are to be published in volume form by the Coal Smoke Abatement Society as soon as possible, and this volume will be on sale shortly at the offices of the Society.

The nine papers read on Tuesday, March 26th, dealt with the effects of a smoke-polluted atmosphere upon buildings, paintings, statuary and plants. Many interesting details were given by Sir Arthur Church, Mr. H. Redfern, Mr. Ruston, Miss Agar, and others, relating to the injury arising from the soot and dust and acid vapours contained in the air of the metropolis and other towns, and to the best methods of preserving stonework, metalwork, and paintings from further harm from this cause. As Mr. Walter Reid pointed out in the discussion, competent architects ought to choose their building materials with an eye to the atmospheric and climatic influences to which they will be exposed, and not to indulge in marble and bronze combinations for the centre of the metropolis. Tuesday's papers and discussions contained much useful information for all interested in this side of the subject, including details of how the old York Watergate on the Embankment was cleaned by L.C.C. workmen, its inches-deep deposit of London soot being removed without injury to the underlying carved stonework.

On Wednesday, March 27th, 16 papers were planned for reading and discussion; the subjects dealt with all related to the work done in organising preventive action, and to the practical methods of securing the abatement of both domestic and factory smoke. Reports upon the progress of the smoke abatement movement in Germany, in England, and in America, were presented by Herr Ing. Nies, of Hamburg; Mr. J. B. C. Kershaw, of Liverpool; and Mr. Thomas E. Donnelly, of Chicago. These reports illustrated the widely different methods of attacking the problem in the three leading manufacturing countries, and will be useful later for reference purposes. On Wednesday afternoon, the more practical subjects of stoking, wasteful power production, and solid smokeless fuels, were dealt with by Commander Caborne, Mr. John S. Pearson, Dr. John S. Owens, and Mr. W. Scott-Moncrieff, and much useful information was given in the papers and in the subsequent discussions. Captain Sankey, who was in the chair at this sitting of the Conference, made a record by disposing of six papers and the discussion upon them in 80 minutes, which suggests that he had studied to good purpose the editorial remarks upon the duties of chairman of Smoke Abatement Conferences, contained in the issue of the Electrical Review of March 15th. The representative of a certain patent fuel caused some amusement at this session of the Conference, by reading a lengthy document setting forth the advantages of this form of coal, but after listening for five minutes to this advertisement for C—l—d, the audience declined to hear more of it, and most effectually applied the closure.

The present laws and prospective legislation relating to smoke abatement engaged the attention of the delegates to the Conference on Thursday, March 28th, when four papers were presented, dealing with this side of the subject. Mr. Joseph Hurst, of London; Principal Graham, of Manchester; Dr. Des Voeux, the treasurer of the Coal Smoke Abatement Society, and Mr. Julian S. Corbett, contributed the papers, and a lively and interesting discussion took place upon the rival policies urged by the two different sections of the Smoke Abatement Society.

The following resolution, which was passed unanimously, indicates the compromise that was arrived at, as the result of Thursday's discussion and joint conference between representatives of the two societies:—"That this meeting of delegates to the International Smoke Abatement Conference recommends that the offer of Mr. A. Gordon Harvey, M.P., to introduce into Parliament the Smoke Abatement Bill prepared by the Smoke Abatement League be accepted, and that should such Bill not be passed into law during the current Session, or should there be no prospect of the Bill passing in 1913, steps shall be taken to organise a deputation to the Government to urge the appointment of a Royal Commission to report upon the whole subject of Smoke Abatement."

Since there is not the slightest chance of the Bill referred to in this resolution being adopted as a Government measure either this year or next, the London Society's proposal for a Commission on the subject of smoke abatement is the most probable outcome of Thursday's discussion.

The other resolutions passed at Thursday's Session of the Conference related to—

1. The adoption of a standard method of measuring the atmospheric soot and dust fall and of recording the density of smoke, and the appointment of a sub-committee to draw up details of the same;

2. The education and training of stokers and granting of certificates to the same for efficiency in their work; and

3. The co-operation of Smoke Abatement Societies in other countries with the proposed inquiry of Pittsburgh University into the economic aspects of smoke abatement.

There were several afternoon receptions held at the Exhibition during the twelve days for which it was open—that on March 27th, when Mr. and Mrs. S. Z. de Ferranti received the guests, being largely attended by electrical engineers. The majority of those who attended this reception stayed to hear the lecture by Mr. Frank Bailey, the joint managing director of the City of London Electric Lighting Co., upon "Electricity for Lighting, Heating and Power," which was illustrated by lantern slides, and attracted a very large audience. The ability to hold the attention of a "popular" audience for an hour, when lecturing upon a scientific subject, is not, however, given to every man. That Mr. Bailey was saved from failure was chiefly due to the fact that he had wisely announced he was keeping his "plums," in the shape of a series of cinematograph films, for the end of his lecture. Had he exhibited these first, his fate might have been that of an amateur lecturer, who, after an eloquent peroration at the end of a lantern lecture on astronomy, found, when the lights were turned up, that he and the reporter were the only remaining occupants of the hall. Like the Arabs, the audience, on this occasion, had noiselessly folded their wraps and stolen away. Many others besides the writer followed a similar example on March 27th, under cover of the darkness, long before Mr. Bailey had arrived at the end of his apparently interminable series of lantern slides, showing electric motors driving rolling mills, printing machines, milling machines, combing machines, grinding machines, and every other type of machine used in this world for manufacturing or industrial purposes.

Kilmarnock Electricity Supply.—The T.C. is to apply to the Scottish Office for authority to borrow £3,750 for extensions at the electricity works.

LEGAL.

WEBB *v.* BOOKER.

In the Lord Mayor's Court on Monday, before the Common Serjeant (Sir F. Bosanquet, K.C.) and a jury, Mr. Arthur O. Webb, constructional and electrical engineer, of Park Hill Road, Haverstock Hill, brought an action against Mr. Harry J. Booker, manager of Messrs. J. & H. Grevener, electrical dealers, of Eldon Street House, E.C., to recover the sum of £50. Mr. Wallington was counsel for the plaintiff, while the defendant conducted his own case.

On behalf of the plaintiff, it was stated that he was the inventor of a certain flame-arc lamp, and the defendant's firm were to exploit the invention if it was satisfactory. The lamps were to be made by a German firm. In order that there might be no difficulty in the construction of the lamps, defendant asked the plaintiff, in 1910, to go to Germany, and instruct the manufacturers in the proper way of making the goods. The plaintiff was promised £100 by the defendant for doing that, and he consented to go to Germany. He received £25 before he went to Germany, and while in that country did all that he had undertaken to do. After his return to this country the defendant handed him a further sum of £50, but the balance of £25 had never been paid. The plaintiff also alleged that he and the defendant were associated in a drawing office. The defendant said that he knew of a drawing office which was "going cheap," and suggested that it should be taken and run in partnership. The defendant thought the office would be useful to both of them, and premises were taken at London Wall. The arrangement was that the plaintiff should draw a salary of £8 a month, and that the expenses should be shared equally, the profits also to be divided between them. The expenses were paid by the plaintiff and the defendant. For some time the profits were shared, but when losses were made the defendant left, and now alleged that he was never a partner in the concern. The plaintiff alleged that the defendant owed him £36 17s. 5d. in respect of the drawing office, but, instead of claiming that sum, he only asked for £25.

The DEFENDANT said that it was agreed between him and the plaintiff that the balance of £25 should only be paid when the lamps had been approved. The number of lamps stipulated had not been approved, and therefore the plaintiff could not claim the money. He denied that he was ever in partnership with the plaintiff in the drawing office. In respect of that venture he had lent the plaintiff various sums of money, and he raised a counterclaim for the recovery of such money, which he said amounted to £27 0s. 7d.

The jury found for the plaintiff for the balance of £25 on the contract for £100, and also for the plaintiff on the counter-claim. They also stated that there was a partnership between the plaintiff and defendant.

MR. WALLINGTON suggested that an account should be taken of the partnership matter, but subsequently said he would not press the matter.

[Other "Legal" matter appears in our "Notes."]

BUSINESS NOTES.

Book Notices.—"Les Conducteurs d'Electricité en Aluminium." By E. Dusaugey. 1912. Paris: Dunod & Pinat. Price 7 fr. 50.

"*Journal* of the American Society of Mechanical Engineers." Vol. 34, No. 4. April, 1912. New York: The Society. Price 35 cents.

THE HILL PUBLISHING CO., LTD., of Bouverie Street, E.C., announce that in future they will publish all books issued in connection with the following New York papers, viz., *Railway Age Gazette*, *Signal Engineer*, and *American Engineer*, as the McGraw-Hill Book Co. have purchased the Book Departments of these papers.

"*Bulletin* of the Association des Ingenieurs Electriciens." December, 1911. Liége: The Association. Price 6 fr.

"Tests of the Absorptive and Permeable Properties of Portland Cement, Mortars and Concretes," together with "Tests of Damp-proofing and Water-proofing Compounds and Materials." By R. J. Wig and P. H. Bates. 1911. Washington: Government Printing Office.

"Quarterly Trade Journal of the British Chamber of Commerce of Turkey." March, 1912. Constantinople: The Chamber of Commerce. Price 2s. 6d.

"*Transactions* of the South African Institute of Electrical Engineers." Vol. II, Part 12, and Vol. III, Part I. January and February, 1912. Johannesburg: The Institute. Price 2s.

"Revue d'Electricité." Vol. XXIX, No. 2. February, 1912. Brussells: E. Bruylant. Price 1 fr. 75.

Correction.—In our reference to Henley's Flexibles, in our last issue, 13/36 S.W.G. should read 14/36 S.W.G.

France.—La Compagnie Popp pour le Traitement des Metaux par l'Electricité is the name of a new company which has lately been formed in Paris, with a capital of £40,000.

Fires.—With reference to our notice regarding the fire at the Ipswich premises of MESSRS. MANN, EGERTON & CO., LTD., of Norwich, the firm states that all arrangements have been made for continuing the business without interruption.

The *Times* states that by a fire which occurred at the moulding works of MESSRS. ROWLAND HILL & SONS, Coventry, valuable machinery was much damaged, and electric light and electric power installations were totally destroyed.

Bankruptcy Proceedings.—ROAD AND RAIL ENGINEERING, LTD., Derby, late Duffield, near Derby.—The first meeting of creditors herein took place last week at the Official Receiver's Offices, 5, Victoria Buildings, London Road, Derby. The winding-up order was made last February on the petition of a claimant for over £6,000. The company was incorporated in October, 1908, as a private concern with a nominal capital of £30,000, having been formed for the purpose of carrying on the business of electrical, mechanical, and constructional engineers, and to develop and place on the market inventions and improvements connected with road, rail, marine, and aerial transport. The company was promoted by Mr. Alfred Richard Sennett, who, although he exercised the powers and duties of director, managing director, and chairman of the board, according to the Official Receiver, did not hold or subscribe for any shares. He was the vendor of certain plant, machinery, &c., at Peckwash Mills, Duffield, as per an inventory which could not be traced, of the benefit of certain inventions and agreements, and of all drawings, &c., relating thereto, the consideration being £13,332, payable as to £8,888 in cash, and as to £4,444 in fully-paid up shares in the company. The agreement, however, was never executed while other agreements for lease, and relating to Sennett's services, were also incomplete. The first two directors, namely, Mr. Philip Yorke and Mr. A. Wilfred Waddy, were appointed by Sennett, but Mr. Yorke ceased to hold the position after the first board meeting, while the address of Mr. Waddy could not be traced. Eventually it was decided that the Official Receiver and Mr. D. Sibbald be appointed for the position of liquidators.

J. TIZZARD, electrical engineer, Hill Crest, Abbey Road, Torquay, Devonshire.—The first meeting of creditors herein took place on April 15th at the Official Receiver's offices, 9, Bedford Circus, Exeter, when it transpired that the debtor had been carrying on business at Torquay from June, 1905, to January last. He started with no capital, and his business had chiefly consisted of fitting up installations for electric light and telephones in private and other houses in Torquay. At the end of January debtor suddenly left Torquay, in consequence of which a petition was presented on the grounds that he had left with a view of defeating or delaying his creditors. On April 13th he returned and surrendered to the proceedings. He stated that his leaving Torquay had nothing to do with his financial position, but was owing to domestic causes. He further stated that he had a balance to the good of some £30 or £40. The Official Receiver pointed out that the debtor had not included a claim by a lady for £100, money alleged to have been paid on his behalf. Debtor, on the other hand, said that this lady was indebted to him for £90, but this was denied. This claim, however, is being very carefully investigated. No resolutions being passed, the matter remains in the hands of the Official Receiver.

Dissolutions and Liquidations.—FIFE ELECTRIC POWER CO., LTD.—A meeting is called for May 14th at 28, Charlotte Street, Edinburgh, to hear an account of the winding up from the liquidator, Mr. J. Watt.

DAVIS ELECTRICAL CO., LTD.—First meetings of creditors and contributories are called for April 30th at 33, Carey Street, W.C.

The summary of statement of affairs shows a deficiency of £4,786. In his observations, Mr. W. J. Warley, Assistant Official Receiver, says:—

"The company was incorporated on October 2nd, 1908, as a private company, with a nominal capital of £3,000, divided into 1,000 preference and 2,000 ordinary shares, all of £1 each. It was formed to acquire as a going concern the business of manufacturer and dealer in electric and other lamps and electrical accessories, previously carried on by the vendor Harry Emanuel Davis, of 17, Moor Street, Cambridge Circus, W.C. Davis states that he was in need of further working capital, and that Charles Levy, who is now his father-in-law, was willing to find funds, upon condition that he received debentures as security. The first and only directors were Davis, Harry Norman Howlett, and Charles Levy. The directors' qualification was fixed at the holding of 10 shares each, and both Howlett and Levy were qualified by the vendor. No remuneration has been voted to the directors as such, but Davis was appointed by the articles managing director for life, to receive by way of remuneration the yearly sum of £500. Howlett also managed a portion of the company's business at £3 10s. per week, with a commission on the net profits. He has overdrawn £62 in respect of commission. Levy resigned from the board on March 15th, 1910. Howlett went abroad shortly before the winding-up order.

"Davis states that he had carried on the business for about 10 years. According to his books the net profits for the three years preceding incorporation were—1905, £559; 1906, £484; 1907, £377. The terms of the purchase were embodied in an agreement dated October 12th, 1908, made between the company and Davis, by which the company agreed to purchase the goodwill and assets, as at January, 1908, subject to the liabilities of that date. The vendor also was to retain £200 in respect of his services in managing the business from January 1st, 1908, to date of completion. The purchase consideration was fixed at £1,998, to be satisfied by the allotment of 998 fully-paid shares of £1 each, and 10 first mortgage debentures of £100 each (forming part of a series

not exceeding £2,000), carrying interest at 5 per cent. per annum and secured upon the whole of the assets of the company.

"The amount of the purchase consideration (£1,998) was arrived at as follows: Assets transferred to company by vendor at January 1st, 1908:—Cash, £297; stock-in-trade, £863; lease of premises, £370; additions to premises, £133; furniture, £45; goodwill, £1,129 = £2,837, less vendor's liabilities taken over in excess of book debts collected, £766; trading loss from January 1st, 1908, to date of completion, £73 = £1,998. On October 12th, 1908, 998 shares were allotted to Davis as fully paid, on November 12th, 1908, ten debentures for £100 each were also issued to him, and the purchase was thereby completed. A further two shares have been issued for cash, and are fully paid. On the same day five debentures of £100 each were issued to Levy for cash then subscribed. According to the books of the company, the result of its trading has been:—From November 12th, 1908, to December 31st, 1908, loss £50; to December 31st, 1909, loss £834; to December 31st, 1910, loss £63.

"In addition to the debentures referred to above, further debentures have been issued from time to time, viz., in September, 1909, five first debentures of 100 each issued to Levy for cash, making £2,000 in all issued in respect of first debentures. In March, 1910, on the occasion of Davis's marriage, first debentures for £1,500 were transferred to the trustees of his marriage settlement, £1,000 out of Davis's name and £500 from Levy. Davis also transferred 960 of his shares to the trustees. On May 17th, 1911, a further issue of £1,100 second debentures, ranking after the £2,000 referred to above, was made, as to £600 to Levy in respect of £300 cash then advanced and for £300 previously advanced, and as to £500 to Davis, being £200 for cash, £200 in respect of an old liability of his taken over by the company, but from which his creditor would not release him, and £100 for salary due. Davis states that some time in September, 1911, owing to delay in payment by some of the company's debtors, he found it necessary to apply for time to certain creditors of the company, who held bills shortly becoming due, but received unfavourable replies; also that he asked Levy to make further advances, but without success. On September 25th he consulted his solicitor, who advised him to call a meeting of shareholders to wind up the company voluntarily. Davis issued the notices on September 28th. On October 6th the resolution for voluntary liquidation was passed, and on the same day Mr. G. E. Corfield, incorporated accountant, was appointed receiver by the debenture-holders, who thereupon entered into, and has since been in possession of the company's property.

"From September 1st to October 6th goods were delivered to the company much in excess as regards value of any delivered during a similar period of trading at any time during the company's existence, viz., £1,614, of which £1,034 relates to the time between September 25th and October 6th (the date of the voluntary winding-up). With the exception of a few small items, the whole of these goods were ordered within a few days of delivery. No creditor in respect of goods was paid after September 15th, but in the fortnight prior thereto accounts for goods amounting to about £310 were paid. Davis's explanation of this apparent method of increasing the debenture-holders' security is that he believed up to the last that Levy would supply sufficient funds to carry on the business, and that liquidation, although provided for, would not be necessary. Having regard to Davis's interest in the debentures, to his relationship to the other debenture-holders, and to the enhancement by the above-mentioned purchases of the debenture-holders' security by at least £1,000 in the period above referred to, the matter will require further consideration. The unsecured claims, £3,358, are in respect of goods supplied, £3,288, printing £3, advertising £15, carriage and freight £10, law costs £17, money lent £25. Davis attributes the failure of the company to lack of working capital and to bad debts."

The Reorganisation and Control Syndicate, Ltd., 2, Coleman Street, E.C.—Under a compulsory winding up order made against this company, Mr. H. M. Winearls, Official Receiver, has now issued his report to the creditors and shareholders. The liquidation accounts show liabilities £2,160 against assets valued at £5,000, but with regard to contributories a deficiency of £5,411. Mr. Winearls reports that the Syndicate was promoted by Mr. Demetrius John Delyannis, and was registered on July 21st, 1909, with the object of acquiring and controlling interest in the London Electrobus Co., Ltd. The nominal capital of the company was increased from £10,000 to £40,000, but only £6,424 shares were subscribed for cash, and £2,000 were issued as fully paid in part payment for the undertaking, garage installation, property and assets of the Electrobus Co. Some of the cash subscriptions were obtained in response to letters and circulars containing statements which will require investigation. The allottee of 40 shares successfully applied to the Court in January, 1911, for the removal of his name from the register of members, on the ground that he was induced to apply for them by misrepresentations.

In June, 1909, the Atlas Banking Corporation, Ltd., of which Mr. Delyannis was at one time principal director, agreed to pay £6,000 cash to the International Motor Traffic Syndicate, Ltd., for £6,000 debentures, £24,000 ordinary shares, and 5,000 deferred shares of 5s. each in that company. The rights of the Atlas Banking Corporation were transferred to the Control Syndicate during July and August, 1909, for £150 in cash and certain further considerations. In the course of litigation which followed between the Control Syndicate and the Traffic Syndicate and another company, the former syndicate was ordered to pay £200 into Court as security for costs. In order to comply with that order, £250 was raised on a debenture for £500, and in August, 1911, the principal and interest due under the debenture being in arrear, Mr. J. H. Byrne, chartered accountant, was appointed Receiver, but up to the present he has not realised anything. He has obtained the leave of the Court to continue the proceedings against the Traffic Syndicate; but unless a substantial amount is recovered, there will be no assets for distribution in the liquidation.

The Langdon-Davies Motor Co. (in liquidation).—Mr. Charles Cape, as receiver for the debenture-holders in this matter, announces that he has disposed of the business for a less sum than is required to pay the amount of principal and interest due to the debenture-holders, and in these circumstances there will be no funds available for distribution amongst the ordinary creditors.

Switchgear Co., Ltd.—This company is being wound up voluntarily. A meeting of creditors was to be held at the office of Messrs. Griffiths, Keeling & Sherwood, 109, Colmore Row, Birmingham, yesterday; Mr. H. Keeling, liquidator. Messrs. Switchgear & Cowans (1911), Ltd., who acquired and are carrying on the business of the Switchgear Co., Ltd., and of Cowans, Ltd., intend to apply to the Registrar for permission to delete the (1911) from their title. They have been informed by the Registrar that the title, Switchgear & Cowans, Ltd., cannot be granted while the Switchgear Co. remains upon the register. A meeting of creditors was called for April 18th.

Stassano Electro-Steel and Furnace Co., Ltd.—A meeting of creditors is to be held at 49, Leadenhall Street, E.C., on April 26th—(*a*) to determine whether an application shall be made to the Court for the appointment of any person as liquidator in the place of, or jointly with, the liquidator appointed by the company; or (*b*) for the appointment of a committee of inspection. Liquidator, Mr. Augustus Hobbs.

Trade Announcements.—With reference to the notice appearing in our last issue respecting the liquidation of Stockall-Brook Time Recorders, Ltd., we are informed that Messrs. G. H. Gledhill & Sons, Ltd., of 153, Cheapside, London, and Trinity Works, Halifax, cash register manufacturers, have bought all the patent rights and the business and goodwill of the Stockall-Brook Co., and will continue the manufacture of these recorders. Having extended their operations to the manufacture of time recorders, and in conjunction with several patents taken out by Mr. A. H. Gledhill, they are now making recorders of various types. Messrs. Gledhill are carrying on this branch of their business under the title of "The Gledhill-Brook Time Recorders." Mr. Frank Brook is retained as sales manager for time recorders, and the works of the late company in Market Street, Huddersfield, are now being employed for contract, repairs and supplies for all makes of such instruments.

The telephone number of Mr. Cecil Y. Knight, London representative of the Morgan Crucible Co.'s brush department, is now 460 Hammersmith.

Mr. Henry Thomas Joy, electric bell fitter, &c., Herne Bay, has removed from 21, William Street to 91, High Street.

The Langdon-Davies Motor Co. announce that their works telephone No. is "Lea Green 1473." All goods and invoices are to be delivered to the works, Eastdown Works, Dermody Road, Lewisham, S.E., and all communications to 110, Cannon Street, E.C.

The Magnet Galvanizing and Plating Co., Ltd, which has been formed with a new board of directors, has acquired the whole of the plant, business and good-will of the Cowper-Coles Galvanizing Syndicate, Ltd. The address is Magnet Galvanizing Works, Stratford, London, E.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, E.C.—The long-expected new 1911-12 edition of the General Electric Co.'s electrical encyclopædia has just been issued, and fully justifies anticipations. In place of the massive tome with which we are all familiar, we now have four bound volumes and a spare binder, fitting into a neat cabinet; the volumes are strongly bound in cloth, with coloured bands which indicate at a glance the nature of the contents, namely:—Vol. I, Dynamos, Motors, Plant and Switchboards; Vol. II, Switchgear, Meters, Lamps, Cables, Conduits, &c.; Vol. III, Fixtures and Glassware, Heating and Cooking; Vol. IV, Telephones, Bells, Cells, Electro-Medical Apparatus, &c. Each volume contains a complete index to the contents of all four, as well as a complete numerical index to the catalogue numbers, showing in each case the volume and page where the item will be found; in many cases there are also at the end of a section or part of a section similar indexes to its contents. An introductory section in Vol. I deals with the various factories and organisation of the General Electric Co., and details its numerous branches in this country and abroad; this volume also contains a section of general and technical information, with approximate estimates of cost of installations and a glossary of technical terms. Concerning the catalogue contents of the volumes we can only speak in general terms; probably most of the sections have been noticed in this column at the time of their separate issue, and when we mention that prices and illustrations are given of nearly every kind of modern appliance connected with electric power, lighting, heating, signalling, telephony and other branches of the electrical industry, it will be obvious that to review so compendious a collection of items would be a Herculean task. The compilation of the work must necessarily have occupied much time, and some alterations made during its progress are indicated by insets; but in order to afford a more satisfactory means of keeping the catalogue up to date, a spare binder has been provided, into which the progress sheets periodically issued by the company can be inserted as received, thus maintaining continuity and completeness between the issue of this catalogue and the next. This binder already contains a few recent bulletins, showing some very fine examples of the company's large generators and other productions, and the private telegraphic code which it

employs. We are informed that each set of volumes actually costs 25s. 6d. to produce, and weighs 15½ lb. The total weight of the first edition equals 48 tons, including 38 tons of paper; each set contains 1,470 pages, and over 10,000 illustrations are given. The utmost care has been taken to exclude all superfluous matter and to improve the catalogue in every possible way, and we can well understand that an enormous amount of work in the aggregate is represented by this unique production, of which we can safely say that nothing like it has ever been previously attempted in this country.

Messrs. Brecknell, Munro and Rogers, Ltd., Thrissell Street, Bristol.—94-page catalogue containing illustrations (art paper), prices, and brief particulars of a variety of manufactures for use in connection with electric traction work. The following are included: Trolley standards, pantograph and bow standards, trolley poles, wheels and heads, many types of line material, trolley standard tools and car-repairing tools, drying stoves for armature and field coils, car fittings, snow-sweeper and rail-cleaner, signalling apparatus, crane and transporter electric equipment and electric locomotives.

Messrs. Haslam & Schontheil, Ltd., 11, Windsor Place, Cardiff.—A leaflet just issued illustrates the "Thor" earthing clip, a new type which will fit any size cable or pipe, and requires no soldering. It also shows the "Thor" watertight hand lamp, in which there are no screws running in a horizontal direction, and the lampholder and lamp cap are completely protected. It is supplied in watertight, keyholder, and non-watertight patterns. Prices are given of both articles.

Messrs. E. Reader & Sons, Ltd., Phœnix Works, Nottingham.—Catalogue and price list of 64 pages containing very full particulars, descriptive and tabular, also illustrations, of their high-speed vertical steam engines of various types, Corliss and other horizontal steam engines, and steam dynamos for ship lighting and other purposes. Prices, weights, dimensions, code-words, and so forth, are given.

The Armorduct Manufacturing Co., Ltd., Farringdon Avenue, London, E.C.—The company has sent us a number of its new "Gral" stickers, being a reproduction of this metal lamp show-card.

Messrs. Quilliam Bros., Clegg's Court, Chapel Street, Salford.—Catalogue of 16 pages containing a description of the Collins patent point controller (type 15) with mercury-sealed stuffing box, for automatically turning tramway points. The illustrations show the mechanism in detail.

Messrs. Scholey & Co., Ltd., 151, Cannon Street, London, E.C.—Twenty-four page catalogue, in which is given full information regarding the firm's direct-current motors and dynamos (type C). Speeds, prices and other particulars are tabulated for motors from 7·5 to 45 B.H.P., also for small direct current motors, "B" type, from ⅛ to 2½ H.P., standard type motor starters. Dynamos, D.C. shunt or compound wound, from 1½ KW. output for 100, 140, 230 and 460 volts are listed, as are also shunt field regulators. Dimension, drawings and half-tone illustrations are included.

Messrs. Arnold, Goodwin & Son, Ltd., Sumner Street, Southwark Bridge, London, S.E.—New catalogue consisting of a series of leaflets describing their air compressing and vacuum pumping machinery. The machines are made for 100, 50, and 25 lb. pressure as compressors, one or two stage, belt, steam and motor driven. Both vertical and horizontal machines are made. The small machines below 50 cb. ft. capacity are of an improved single-acting vertical type.

The British Thomson-Houston Co., Ltd., Rugby.—A number of new lists have been issued in the firm's standard size and style for filing, as follows:—No. 329, electric hair dryers; No. 330, oil-immersed γ-delta switches for starting squirrel-cage induction motors; No. 331, continuous-current motors and generators (type DG); No. 332. Tirrill regulators; No. 334, automatic circuit-breakers (type C, form P); No. 335, high torque A.C. wattmeters, single-phase; No. 336, adhesive insulating types. All of these, excepting No. 329, are in supersession of pamphlets previously issued. In most cases prices are tabulated, and dimension particulars are given. No. 332 is a 16-page list containing a useful description with voltage records, diagrams, &c., of the Tirrill regulator, its construction, operation, &c.

Messrs. Pritchetts & Gold, Ltd., 58, Victoria Street, London, S.W.—New 8-page section of their catalogue (No. 121) giving illustrated particulars with weights, prices, &c., of portable batteries for the lighting of motor cars, carriages, yachts, &c., for driving automobiles and launches; for laboratory and medical work; also for firing fuses, ignition work, and hand lamps.

Messrs. W. & R. Jacobs, 39c, King William Street, London, E.C.—Leaflet showing and stating prices of a number of new designs of bead cascade shades for electric fittings.

The Edison & Swan United Electric Light Co., Ltd., 36 and 37, Queen Street, Cheapside, London, E.C.—Leaflet No. A 2235 giving brief illustrated particulars and prices of their no-waste dimmer lamp adaptor for sick-room, nursery and other service, where a bright or dim light is required at will.

Hotel with 200 Electric Clocks.—The new Liverpool Adelphi Hotel of the Midland Railway Co., which was opened recently, is supplied with uniform and accurate time throughout by an installation of upwards of 200 electrical impulse dials on the "Synchronome" system, all operated by one controlling pendulum. With the exception of 40 in the service and servants' quarters, the dials are all of Parisian enamel on copper, supplied by Messrs. Henri Picard & Frère, and set in elaborate cast-brass hand-finished cases, specially designed by the architect to harmonise with their surroundings, and made by Messrs. Veritys, Ltd. Even the bedrooms are provided with clocks, which are fixed on the walls. It is above all things necessary that electric clocks in bedrooms should be silent in action, and the officials of the Midland Co. instituted a long series of tests some 18 months ago, with dials of four different systems. The "Synchronome" system was selected because its dials could not be heard in the silence of night. The whole installation was carried out at a month's notice by the Synchronome Co., Ltd., of 32 and 34, Clerkenwell Road, in time for the opening of the hotel before the Grand National.

Prices Advance.—The General Electric Co., Ltd., of 67, Queen Victoria Street, London, E.C., announce that, owing to the increased cost of raw materials, they are compelled to advance all prices in Section W of their catalogue relating to wires, cables, line material, &c., 10 per cent. on and after April 22nd. This is supplementary to the March 1st notice, which notified this advance as applying to pages 898 to 913, containing the prices of articles constructed wholly or partly of iron or other metal, such as insulators, bolts, &c., for line construction. The present notice extends this advance to the whole catalogue with the exception of tin wire and solder, where the special 20 per cent. advance already notified is maintained.

The Ideal Home Exhibition.—We are informed that the new "Corona" 1912 type annealed tungsten wire lamp of the Corona Lamp Works, Ltd., has been selected in conjunction with the Lister-Bruston patent automatic electric lighting plant, manufactured by Messrs. R. A. Lister & Co., Ltd., Dursley, for the exclusive lighting of the ideal house, in the *Daily Mail* Ideal Home Exhibition, now running at Olympia.

LIGHTING and POWER NOTES.

Acton.—At Tuesday's Council meeting the special Electricity Committee notified consideration of correspondence which had passed between the Council's solicitor and the solicitors to the Metropolitan Electric Supply Co., with regard to the negotiations for a settlement of matters between the Council and the company respecting the transfer to the latter of the Council's electricity undertaking. Addressed to the Clerk to the Council came a letter from the secretary to the company, enclosing a cheque for £373, and a statement showing a reduction from the amount of the instalment interest due in respect of loan, proportionate to the amount of capital unexpended, £5,711, which the Council had retained, and which the company claimed. It was resolved that the cheque be returned, and that the Council's solicitor be instructed to consider what action should be taken to recover the full amount of the loan instalment and interest.

Algeria.—A central electricity generating station has recently been installed to supply the necessary current for lighting and power purposes at the iron-ore mines of the Société des Mines de Fer de Rouina, at Rouina.

Bath.—The Street Lighting Committee of the Council has successfully recommended that seven arc lamps and 17 gas lamps, including one triple burner gas lamp, be dispensed with, and that 47 metal-filament lamps be put up in their place.

Birmingham.—On April 10th a L.G.B. inquiry was held into the application of the T.C. for a loan of £43,030 for the electricity undertaking, viz., extension of buildings, sub-stations, high-tension mains, two rotary converters and transformers. There was no opposition.

Blackburn.—A loan of £1,050 for electricity purposes has been applied for by the T.C.

Christchurch.—The B. of G. has been recommended by a Committee to have the workhouse lit by electricity, rather than by petrol or air gas. The recommendation is being considered by the Visiting Committee.

Clacton-on-Sea.—The U.D.C. has been informed by the trustees that the electric light will be installed at the new Convalescent Home for Children, and current will be taken from the Council.

Clayton-le-Moors.—Last week there was an inquiry as to what steps were being taken to further the construction of the proposed Clayton-le-Moors light railway. A letter was read from the Lancashire and Yorkshire Railway Co. stating "that the order sanctioning the construction of this railway has not yet been granted by the Light Railway Commissioners, and after it has been granted it has to be submitted to the Board of Trade for their approval." The Light Railway Commissioners have since granted the order.

Continental Notes.—Austria.—Experiments are being made on the Hungerberg, in Vienna, with the surplus water power of the high springs reservoir. The object is to utilise the water power, and a turbine has been placed in the water tunnel for generating electricity. The water thus utilised yields about 2,000 H.P., which it is intended to apply to the purpose of public lighting.—*Zeit. Oest. Ing. u. Architektenvereines.*

The old hand-loom linen and cotton weaving mill of Messrs. Johann Hoffmann, at Benniech, Austrian Silesia, is about to be replaced by a new mill the firm are erecting, and in which about 80 electrically-operated looms will be installed.

Luxemburg.—A scheme has been under consideration for some years to dam the Upper Sure, between Perlé and Nagem, and form

a reservoir. Lately the idea has assumed more tangible shape by the application made by a group of foreign capitalists for a concession. The plans, drawn up by Engineer Klein, outline the erection of a reservoir 54,000,000 cb. m. capacity for supplying a large water turbine plant. The power station will be equipped with a series of generators of 6,000 and 12,000 H.P., with a steam reserve plant to meet eventualities. The current can be distributed throughout the length and breadth of the Grand Duchy, for lighting and motive power purposes, and probably the working of the railways. The primary current will be supplied at 5,000, 30,000, and 50,000 volts, and stepped down at various transformer stations. The dam, built of armoured concrete, will be 42 metres high. A similar scheme carried out by the Belgian Government at Gileppe cost about 5,800,000 fr. The estimated cost of the present scheme is 16,000,000 fr., which the promoters are prepared to find.—*Electro.*

Spain.—What is claimed to be the highest voltage electrical transmission system in Spain is that being established by the Sociedad La Energia de Cataluna. The concern is putting down a large water-power plant in the Pyrenees, and will transmit the electrical energy generated to Barcelona, a distance of 200 kilometres, at a pressure of 80,000 volts.

A society has been formed at Felanitz, Balearic Islands, with a capital of 1,250,000 pesetas, with the object of installing an electric light service.—*Electron.*

Norway.—The capital of Norway owns water powers to the extent of 28,000 H.P. These are now to be utilised for the production of light and power. The city has granted to a private firm a concession for 30 years, at the end of which period the entire installation becomes the property of the municipality.—*Electro-industrie.*

Russia.—La Société des Tramways de Witebsk is in negotiation with the municipal authorities of Witebsk with reference to a concession for the electric lighting of the town.

The Kharkov municipal authorities have contracted a loan of about £633,000, which is to be employed for carrying out drainage works, electric light works, and for the construction of an electric tramway.—*Board of Trade Journal.*

Cornwall.—A syndicate which is investigating the possibilities of electrifying the tin mines in Cornwall has engaged Mr. E. M. Lacey, consulting engineer, to prepare a report.

Douglas.—The Electrical Undertaking Committee of the T.C. recommended the Council to apply for borrowing powers to the extent of £5,500, for the purpose of carrying out a scheme of lighting and ornamental illumination by means of electricity of the sea-front during the summer season. The scheme included the festooning of the whole length of the marine promenades with lamps on the lines which proved so effective last summer. The electricity was to be produced by Diesel engines and generators. The T.C. has, by the casting vote of the Mayor, rejected this recommedation. In Committee the voting was six for and one against, and as the division at the Council meeting was equal, the Mayor declined to give his casting vote for the scheme.

Devonport.—A L.G.B. inquiry has been held relative to the Council's application for sanction to borrow £9,983 for extension of buildings and plant at the municipal electricity works. The increasing demand on the undertaking made it necessary to provide additional generating plant to meet next winter's load. The present plant capacity was insufficient to meet this, while making allowance for the necessary stand-by. The largest items were £6,460 for a 1,000-KW. turbo-generator with condensing plant, air filters, foundations, piping, valves, traps, circulating water tank and cable between generators and switchboard; and £1,148 for a coal store.

Dundee.—The Corporation has arranged to supply a shipbuilding yard with current for motors; over 400 H.P. will be required to drive the various machines. An 80-H.P. motor direct-coupled to an air-compressor is completed, and running with satisfactory results. The Harbour Board has installed flame arc lamps to light one of the graving docks; also eight cast-iron plug boxes, fixed at various points about the dock for the purpose of supplying power and extra lighting when a vessel has to be repaired at night and during the winter months. In each box two plugs are for 50 amperes at 400 volts for power, and two for 25 amperes at 200 volts for lighting. The installation is connected to the Corporation mains.

Greenock.—To cope with the greatly increased demand for current, the Corporation has recently made important additions to buildings and plant. On Thursday, last week, a large company gathered to witness the starting of a Westinghouse-Rateau 2,000-KW. turbo-alternator by Mr. J. W. Bailey, convener of the Electricity Committee. After the ceremony, Provost McMillan described the growth of the department, and stated that their output was now over 10,000,000 units a year.

At the meeting of the T.C. on 16th inst., Mr. J. W. Bailey submitted the proposals which had been arranged between the Electricity Department and the Port Glasgow T.C. The agreement was to the effect that no other competitor would get into Port Glasgow for the supply of electricity for 30 years, and that the T.C. there would get the power at the same price as Greenock consumers, with 5 per cent. extra for converters where they were used. The Port Glasgow power users had agreed to allow themselves to be assessed on the value of their works in the event of any deficiency requiring to be made up. Mr. Thomas Baxter proposed that no supply be given unless 5 per cent. extra was paid on current and 10 per cent. where rotary converters were used. His position was that Greenock had already taken all the risks in the capital expenditure and in bearing the losses at the start, and Port Glasgow now wanted to come in and get all the benefit. Provost M'Millan pointed out that Port Glasgow would not share in the profits of the undertaking, and last year the ratepayers received a reduction of 1d. in the £. The arrangements were approved.

Glasgow.—After considering a report by the engineer regarding the laying of additional H.T. mains to the Whitevale substation, and to the new substation to be erected in the Irongate district, and also the distribution of electrical energy in the eastern district of the city, and in the Irongate district, the Electricity Committee has agreed to an expenditure of £22,705 for carrying out this work.

Haverfordwest.—The T.C. has appointed a committee to consider the advisability of lighting the town by electricity.

Kirkburton.—The U.D.C. has granted permission to the Yorkshire Electric Power Co. to erect overhead wires at Dogley Mills for the transmission of current.

Lanark.—An electrification scheme has been carried out in connection with a group of pits in Lanarkshire, belonging to the United Collieries, Ltd. These collieries are:—Bredisholm, Calderbank, Ellismuir and Clydeside. The electrical engineers responsible for the scheme are Messrs. D. Selby Bigge & Co. Two mixed pressure turbo-alternators of the Dick, Kerr-Bergmann type are installed, one at No. 3 pit, Bredisholm, and the other at the Calderbank pit. Each turbo-alternator is capable of developing 600 KW., at 3,000 R.P.M. The alternators generate three-phase current at 3,000 volts and 50 cycles. The exciters are carried on the end of the turbo-alternator shaft, and there is also installed in each station a separate motor-driven excitation set. A Thury automatic voltage regulator is installed. An exhaust-steam regenerative accumulator by Messrs. Richardsons, Westgarth, is installed at each station to deal with 24,000 lb. of steam per hour, and is capable of bridging engine stops of 45 seconds duration. The H.T. switchgear is by Messrs. Dick, Kerr. The various pits in the group are linked up by bare aluminium overhead transmission lines, and the system is so designed that either generating station may supply the complete network, or the two stations may run in parallel. A 206 K.V.A. step-down transformer is installed at Bredisholm, No. 3 Calderbank, and No. 3 Ellismuir pits, and a 112 K.V.A. transformer at Bredisholm No. 2 pit, for supplying motors below 75 H.P. at 500 volts, and at Clydeside Colliery a motor-generator of 265 KW. capacity is installed for supplying previously existing plant with direct current at 500 volts. The transformers are by the British Westinghouse Co., and the motor-generator by the British Thomson-Houston Co.

Liverpool.—On Monday evening last the whole of the public electricity supply in the city was shut down for three-quarters of an hour at 9 p.m. No explanation has been given of this extraordinary occurrence, which in view of the inconvenience attendant on a failure of such magnitude, appears to call for the fullest inquiry.

Lowestoft.—The T.C. has decided to apply to the L.G.B. for a loan of £2,000 for house services.

Malvern.—The U.D.C. has applied to the L.G.B. for a loan of £2,000 for cables for mains extensions for two years.

The charges for the meter hire have been reduced to 2s. 3d. per quarter for 30 lights, and to 3s. 3d. for over 30 lights. This will reduce the revenue by £50 a year.

Merthyr.—The T.C. has agreed to the erection of transformer stations at Treharris and Merthyr Vale, and the plans submitted by the Merthyr Electric Traction Co. have been passed.

Prestwich.—Owing to negotiations between the Council and the Salford Corporation Gas Department having fallen through, the clerk has been instructed to approach the Salford Corporation Electricity Department regarding a supply of electricity for house and street lighting on the Moorfields Estate, and also to ascertain terms for street lighting for the whole district.

Sevenoaks.—After consultation with the B. of T. the U.D.C. has accepted the offer of Messrs. Crompton & Co. to take over the E.L. order, subject to the consent of the B. of T. If this is secured there will be a supply of current available within a year.

Skelton and Brotton.—The U.D.C. has accepted the tender of Messrs. Graham Bros., of Middlesbrough, for lighting the district by electricity. The change from gas will take place in September, 1913.

South Africa.—In connection with a proposal to increase the debenture issue of the Victoria Falls and Transvaal Power Co., Ltd., the secretary states that the Victoria Falls Co. has received applications for electric supplies amounting to 52,000 H.P., while, in addition, the Rand Mines Power Co. has received applications for electrical supplies of 67,000 H.P. and 66,000 H.P. of compressed air, making a total notified demand of 185,000 H.P. The total generating plant capacity installed, including reserve, amounts to 132,000 H.P., and the fresh capital is needed to supply the surplus demands.

South Molton.—The T.C. has decided to interview a representative of Messrs. Crompton & Co. with reference to a proposed E.L. scheme for the borough. The firm offers to work an order for the Council, or to form a syndicate for financing a scheme.

Stanwix.—The Carlisle T.C. has decided to proceed forthwith with the laying of cables to Stanwix.

Walsall.—Negotiations are proceeding with the L. and N. W. Rly. Co. with a view to supplying them with current. The question of letting out motors and other plant on hire is to be taken into consideration. The Electricity Committee has adopted various recommendations for forming a progressive maximum scale of salaries to be paid to the officials and workmen in the electricity department. By these recommendations immediate increases to the aggregate of £30 13s. per annum are involved.

West Bromwich.—A L.G.B. inquiry was held last week respecting an application by the T.C. for sanction to borrow amongst other items, £7,700 for the extension of the Corporation's electricity works. The borough treasurer explained that for the first two years—1902 and 1903—of its working there was a loss of £1,840. From 1904 up to the present time, however, the concern had yielded a profit of £15,126, out of which £4,800 had been contributed to the relief of the rates. The consumption of electricity showed an increase for the past year of 600,000 units over the previous year. The present plant, it was also stated, was barely adequate to meet the growing demands, hence the extensions and the application, to which there was no opposition offered. At the conclusion of the inquiry, the Inspector visited the electricity works and promised to report.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Tramways Committee has unanimously agreed to recommend the adoption of the P.A.Y.E. system on six new cars, which will be tried on the Mannofield route; it has also been agreed to adopt a certain type of wind screen, costing £5 per car, for the protection of the driver, this having been decided on as the result of experiment in the city.

Ayr.—A deputation from the Corporation is to visit Leeds and Bradford, to inspect the railless trolley system of traction.

It is proposed to extend the Ayr system to the new racecourse by way of George Street.

Belfast.—On Monday the Tramways Department issued a return showing the revenue, net revenue and appropriation accounts of the undertaking up to March 31st. These reports show that the total revenue amounted to £243,074, or an increase of £24,773, and the working expenses to £129,777, or an increase of £16,818. This leaves a working profit of £113,297, or an increase of £7,995. The net revenue charges, including interest on debt, the annual fixed payment of £8,961 to the general purposes fund, income-tax, stamp duty, amount to £52,299. The net revenue, or disposable profit therefore amounts to £60,997, being an increase of £6,946 over the previous financial year. The actual disposal of the net revenue is definitely fixed by the Act of 1904, and it will be appropriated as follows: Sinking fund, £24,554; depreciation fund, £13,000; general purposes fund, £24,443, making a total of £60,997. The anticipated income of the present year is £260,000; working expenses, £135,500; working profit, £124,500; net revenue charges, £50,500; net revenue, £74,000.

At the fortnightly meeting of the Tramways and Electrical Committee, Mr. B. Croft was appointed chief assistant to the electrical engineer, in room of Mr. A. N. Moore, appointed to another cross-Channel post.

The extensions of the tramway lines in various parts of the city are to be commenced this week, it is understood.

Continental Notes.—Germany.—The benzol-electric railway, which has been built by the authorities of Schmöckwitz, and runs to the neighbouring town of Grünau, through the Royal forest and along the shores of the Lange Lake, has just been inaugurated for working.

Sweden.—The electrification of the State Railway network is making steady progress. The Government is steadfastly pursuing the realisation of its great scheme of electrifying the whole of the southern network, as the recent measures for the acquisition of waterfalls show. The network destined for electrification stretches from the Bollnass Station to the main line going northward to Lapland. The several northern lines, on the other hand, are not considered in the scheme, with the exception of those employed for the transport of iron ore from the mining district of North Sweden, as the frontier line and the Lulea-Gellivare line, which, as is well known, will be worked from the power station at the Porjus Falls. The lines of the southern network to be electrified comprise the most important main lines, the first in order being the Stockholm-Gothenburg line in the west and that to Malino in the south. The abundant water-power that exists in the southern parts of Sweden facilitates the carrying out of electrification on the amplest scale. One of the first steps in this direction is the agreement come to between the Government and the State Waterfalls Department on the one hand, and the Stockholm Electricity works on the other for the electrification of the Stockholm-Marsta and the Gothenburg-Alingsäs sections. For the latter the great power house at Trollhattan Falls will supply the power. At the moment the Government is negotiating for the acquisition of several rapids on the Motala stream. According to the plans of the Railway Department it is intended to build two power stations on the last-mentioned stream, at waterfalls owned by the State, for the working of sundry southern and western sections, and notably the Järna-Nyköping-Norrköping line, now under construction, which will slightly shorten the journey for Swedish-German traffic. On the opposite side of Sweden the distribution network of the Trollhattan power station already reaches as far as Skofele, and will be eventually extended to Läxi at least, north of the Wettern Lake, coming into touch with the network of the power station on the Motala stream which is to be built. Furthermore, the Government is building a great power station at Elfkarleby Fall, from which energy will be distributed as far as Katrineholm and Nyköping. With these power plants the State will be able to provide for the whole of middle and southern Sweden, with the exception of the remotely southern parts, which, however, will be served by the networks of several private companies. For these districts, however, the Government will also shortly cater, by means of a power station which is to be established at the Karse Fall. It is, therefore, only a question of time for the Swedish Government to supply the power requirements of the whole of its railway network, in the southern half of the kingdom at least.—*Elektro. und Maschinenbau.*

Spain.—A Royal Decree has been published in the *Gaceta* annulling the concession for an electric tramway from Renteria to the French frontier, granted to Don Gonzalo Hernandez and Perez Medel, owing to the non-fulfilment of obligations officially imposed.—*Electron.*

Russia.—A Belgian syndicate has secured a concession for the construction and working of a system of electric tramways in the town of Riga.

Switzerland.—The Elektrische Strassenbahn im Kanton Zug Gesellschaft is the name of a new company which has lately been formed at Zug, with a capital of £280,000, to construct and work a system of electric tramways in the district.

Dundee.—The extension of the ½d. stages on the local tramway system has again engaged the attention of the Tramways Committee of the T.C. It will be remembered that the stages were considerably shortened when the 1d. all-the-way fares were intr o duced, but it was then hoped that any surplus on the year's working would go to benefit the ½d. stages. Mr. Fisher, the manager, in speaking on the proposal, said that while they thought the uniform charge over the system would be popular, they knew they would lose money. They estimated for a drop of £2,200 in the revenue, leaving only £2,900 to be placed to the renewal account, as against £5,550 the previous year. While the coal strike and the ideal tramway weather had benefited the tramways to a great extent, he was of opinion that the Committee was not yet in a position to make a proper comparison with any previous year, and he recommended that no change be made in the meantime. He suggested that they lay aside £4,500 for renewals. The Committee, after discussion, agreed that no change be recommended to the T.C. this year.

Glasgow.—A lengthy discussion took place at the last meeting of the T.C. on a proposal to give the general manager power to replace 100 of the converted horse cars still in the service of the department by a similar number of cars of the latest type such as are at present under construction at the departmental works at Coplawhill. The main points raised were the suggestions that double bogies should be introduced, and that the cars should be made half as long again as at present, so as to diminish oscillation on the double-decked type of cars and permit of a larger carrying capacity during the busier hours. It was argued in opposition that the double bogie had been tried on the early cars, but had been discarded, while to lengthen the cars would mean the tearing up and relaying of considerable lengths of rails at some of the more acute angled street corners. The original proposal was adopted. It is understood that in the new cars few new features are being introduced, the main point being an increased wheel base and a lengthened truck to reduce oscillation.

London.—The L.C.C. has decided to enter into an agreement with the Metropolitan Tramways, Ltd., for through running of cars between Euston Road and Enfield Town, *via* Camden Road and Seven Sisters Road. It is expected that through running arrangements will be instituted to other points in Middlesex at later dates.

Paisley.—The T.C. has for some time past been pressing the Paisley and District Tramway Co. to carry out the construction of the lines in the Meikleriggs and Greenock Road districts, for which sanction was obtained under its order. It was reported at the last meeting of the Electricity Committee that the company's agent had said that the company might be prepared to put on motor-buses, if the Corporation consented to the repayment of the amount deposited in security of its obligations under the Acts.

Renfrew.—A reply has been received from the B. of T. to a letter sent by the T.C. regarding the alleged dangerous swaying of the Paisley and District Co.'s double-decked cars. The board states that it had obtained drawings of the cars, and had to advise the Council that there was no danger. It, however, considered that the centre of gravity should be lowered, and had suggested that in any new cars to be built the tramways company should pay attention to this. In discussing the communication, the opinion was expressed that, to a great extent, a remedy would be effected if the tramway company put its track into proper repair. The clerk was asked to again write the Board on the matter.

Rochdale.—The year's working of the tramways has produced a net profit of £6,486, the largest surplus realised since the undertaking was electrified and brought under the Council. From the amount named an item of £580 overspent on capital account is to be met. The balance of £5,904 it is proposed to allocate to a

depreciation fund for renewal of track, &c., on which heavy expenditure is anticipated in the near future. The total income amounted to £73,002, compared with £63,000 for the preceding 12 months. The working expenses were £37,367, against £34,355, and the gross profits £35,635, against £28,644.

West Hartlepool.—A B. of T. inquiry was held on the 11th inst. into the application of the Corporation for a prov. order empowering it to construct new lines in Lynn Street, Musgrave Street, Park Road, Wooler Road, and Hart Road. Mr. Kinder said the Hartlepools line was constructed in 1886, the Park and Foggy Furze sections in 1895, and the Seaton Carew light railway in 1897. The Park and Foggy Furze sections had been purchased by the Corporation of West Hartlepool, and were now being worked by the Tramways Co. under agreement. The proposed new lines would, with the existing lines, connect the railway station, the shopping centres, the amusement centres, the public markets, and the residental centres. The length of the new sections would be 4¾ miles, and they were designed to serve a population of 30,000. The West Hartlepool Corporation was negotiating with the Hartlepools Tramways Co. for the purchase of the Seaton Carew line and with the General Electric Tramway Co. for the lease of that part of the Hartlepool section that was in the Hartlepool borough. If these negotiations failed the West Hartlepool Corporation was prepared to have a clause inserted in its Order giving powers for mutual through running.—Mr. Jones said all the tramway companies asked was for the insertion of a clause that, failing the purchase by the Corporation, the companies might have power to run over the Corporation's lines to Church Street, and to this Mr. Kinder agreed.—The Inspector said that they could take it as agreed that there would be a clause for mutual running powers. During the inquiry, Mr. Hamilton (Leeds) gave evidence in favour of the scheme, pointing out the advantage of cheap energy, derived from waste heat, to the Corporation.

Worsley.—It is reported that arrangements are to be made whereby the service on the South Lancashire Tramways Co.'s section from Worsley Court House to Winton, is to be fully resumed. This service connects with the Salford Corporation system at Winton.

TELEGRAPH and TELEPHONE NOTES.

Congo State.—The Government has allocated £68,000 for the establishment of wireless telegraph stations in the Congo State during 1912.—*Board of Trade Journal.*

France.—It is proposed to lay a new submarine telegraph cable between Marseilles and Algiers, and to erect a new telegraph line between Paris and Marseilles.

Germany.—A wireless station of the largest dimensions is to be built on the Rübenberg, in Neustadt, Hanover. The chief mast of the station will be 350 metres high.

Italy.—The Italian Telegraph and Telephone Department have just commissioned the Bell Telephone Manufacturing Co., of Antwerp, to extend the telephone exchange at Rome, equipped by that firm some years ago. Since the taking over of the telephone service by the State, the Bell Co. have equipped not only the exchange at Rome, but those at Milan, Naples, Catania, Genoa and Turin.—*Electro.*

Japan.—A new telegraph cable has just been completed between Osaka and Tokushima.

Telegraph Clerks.—The annual Conference of the Postal Telegraph Clerks' Association was held at Cardiff, on Friday and Saturday last week.

According to a recent official statement, the London Central Telegraph Office employs 4,456 persons, and the London Telephone Service 1,796 persons. The former includes 13 superintendents, 112 assistant superintendents, and 158 overseers, with 1,632 telegraphists, and 387 members of the cable-room staff. The latter comprises 12 exchange managers, and a female staff consisting of one superintendent, three supervisors, 160 assistant supervisors, and 1,402 telephonists.

Wireless at Sea.—The awful catastrophe by which the s.s. *Titanic* was wrecked and over 1,300 persons lost, again exemplified the enormous value of wireless telegraphy on board ship. The collision was immediately made known by its means, not only to the shore station at Cape Race, but also to a large number of vessels, and the fact that none of these was able to reach the spot before the ship foundered was due, not to any shortcoming on the part of the wireless system, but simply to the unfortunate circumstance that they were all too far off to cover the distance within the four hours at disposal. The speedy rescue of the survivors from the boats was wholly due to the accurate information as to their whereabouts supplied by wireless telegraphy, which also kept those on shore acquainted with the state of affairs. The apparatus on the *Titanic* was that of the Marconi Co., whose operators dauntlessly remained at their post until, for some reason, transmission became impossible; one of them, Mr. Bride, was fortunately rescued, but the other, Mr. Phillips, is missing, and we fear he went down with his fellow heroes, who placed the safety of others above their own.

Wireless Fog-Signalling.—Two new applications of wireless telegraphy for the purpose of protecting vessels against the risks attending sea-fogs have recently been mooted—one by a French inventor, Lieut. Lair, the other by Mr. Marconi. Details are not at present available.

Wireless Telegraphy and Aircraft.—The question of fitting military aircraft with apparatus for wireless telegraphy is of considerable interest and importance, and Marconi's Wireless Telegraph Co. have of late given much attention to this problem. Experiments have recently been carried on at the Army Aircraft Factory at South Farnborough. Late in March an Army aeroplane went out for a short flight fitted with a clockwork V sender, and from it good signals were received. Early in April similar experiments were carried out, but in these, Capt. Dawes, of the Air Battalion, went as a passenger and transmitted his observations to the receiving station at the factory. The messages which he sent were very clearly received. Later, the machine flew over an area of 3 or 4 miles' radius from the aircraft factory, and Capt. Dawes was able to report on the movements of troops manœuvring in the vicinity. These reports, which would have been of the utmost military value, were taken down at the receiving station, which was in touch with the aeroplane during the whole of the flight. On the third circuit Capt. Dawes himself received the messages which the Marconi operator transmitted from the aeroplane. The experiments, which were for the purpose of demonstrating the efficiency of the special Marconi apparatus employed, were thus entirely successful.

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-under-Lyne.—May 1st. Two sets of counter-current jet condensing plant with steam-driven pumps, and one natural draught wooden chimney cooler, for the Borough Electricity Department. See "Official Notices" April 12th.

April 23rd.—Electric wiring of the Workhouse. Specifications, &c., from Mr. G. H. Partington, clerk to the Guardians, Poor Law Offices.

Australia.—Victoria.—May 1st and 8th. Cable for P.M.G.'s Department.

May 6th.—Arc lamp carbons for the Melbourne City Council. See "Official Notices" to-day.

May 14th.—Telephones, switches, condensers and protectors, for Melbourne. See "Official Notices" March 22nd.

May 15th.—Electric vehicles for the Electric Supply Committee of the City Council of Melbourne. See particulars in this column for April 5th.

June 4th.—1,000 protectors, galvanised iron wire, galvanised steel wire and sleeves, for the P.M.G.'s Department. See "Official Notices" to-day.

May 21st.—P.M.G., Melbourne. 30 miles of cable, 24¼ miles of cable, 699 non-polarised relays. See "Official Notices" April 12th.

May 28th.—Deputy P.M.G., Melbourne. 100 tons bronze wire, 262 tons of hard-drawn copper wire, 188,500 copper binders, 11,500 sleeves, and 126,000 copper tapes (Schedule No. 686). Specification can be seen at the Board of Trade Commercial Intelligence Department.

July 23rd.—P.M.G., Melbourne. Nine sections of a lamp-signalling trunk-line switchboard. See "Official Notices" April 5th.

Queensland.—May 8th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" March 15th.

May 8th.—Telegraph and telephone instruments, switchboards and accessories, measuring instruments and protectors, for the P.M.G.'s Department. See "Official Notices" March 22nd.

Western Australia.—May 8th. Common-battery telephones, for the P.M.G.'s Department. See "Official Notices" March 22nd.

Tasmania.—June 10th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" April 12th.

N.S.W.—Three centrifugal pumps (12,000 gallons per minute), five 350-kw. transformers, A.C. motors, for White Bay power house, for N.S.W. Government Railways and Tramways Department. Electrical Engineer's office, 61, Hunter Street, Sydney.

Austria.—April 25th. The authorities of the Austrian Northern Railway in Vienna are inviting tenders for an installation of electric lighting, comprising 80 arc lamps, at the railway station at Oderberg.

Bedford.—Electrical plant (100 lights) for the Powage Press, Ltd. See "Official Notices" to-day.

Belgium.—May 20th. The municipal authorities of Bilsen (province of Limbourg) are inviting tenders for the establishment of a central electric lighting station in the town. Particulars may be obtained for 3 fr. from, and tenders are to be sent to, Le College des Bourgmestre et Echevins, Bilsen (Limbourg).

Bolton.—April 25th. Materials and stores for a year, for the Corporation Electricity Department. See "Official Notices" April 12th.

(*Continued on page* 645.)

INTERNAL COMBUSTION ENGINES FOR ELECTRICAL INSTALLATIONS.

The Körting Gas Engine.

It is some 10 years since Messrs. Mather and Platt, Ltd., of Manchester, took up the manufacture of the Körting type of two-cycle, double-acting gas engine; and during this period they have modified and simplified the design in accordance with experience, in order to obtain a machine which could be considered reliable for every class of work and varying conditions of load. From the point of view of simplicity, it is claimed that the present design is a very big step in advance of anything yet attempted in internal-combustion engine design, and has resulted not only in reducing cost for upkeep and attention, but also in greater reliability. This is borne out by the non-stop runs carried out with several installations, the engines running continuously for periods of four to five months at a time without any stop whatever, and recently one of these engines ran continuously for one month directly after starting up in the first instance.

It will be noticed that all side shafts, with their accompanying gears, cams and levers, have been dispensed with, as well as the mechanically-operated valves on the pumps. What remain now are simply the two inlet valves, which receive their motion through a rod and eccentric directly from the crankshaft. The valves in the pump are all automatic, and are mounted in a cage which is easily removable.

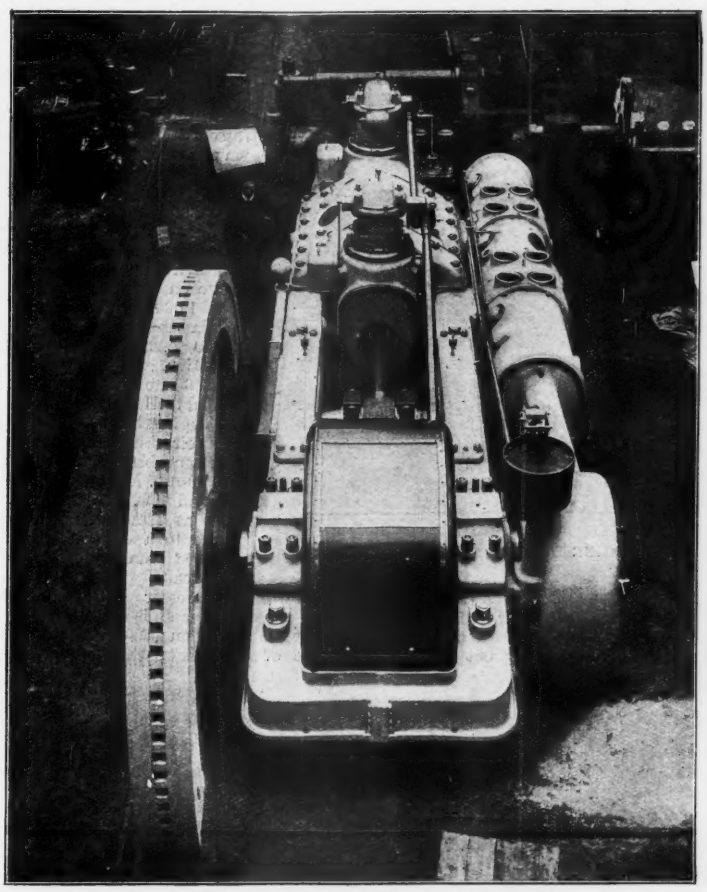

Fig. 1.—600-b.h.p. Single-Cylinder Two-Cycle Körting Gas Engine.

Messrs. Mather and Platt have carried out a number of large gas-engine installations, where the engines are used to generate electricity, using various classes of fuel, such as bituminous and anthracite coal, coke, wood shavings, &c., town's and coke-oven gas, and blast-furnace gas, and the engines have given satisfactory results under all conditions.

Fig. 2 shows three 500-b.h.p. twin-cylinder gas engines direct coupled to three-phase alternators; the engines use gas made from colliery waste fuel, the by-products being first extracted from the gas.

Fig. 1 shows a single-cylinder two-cycle gas engine of 600 b.h.p. in Messrs. Mather and

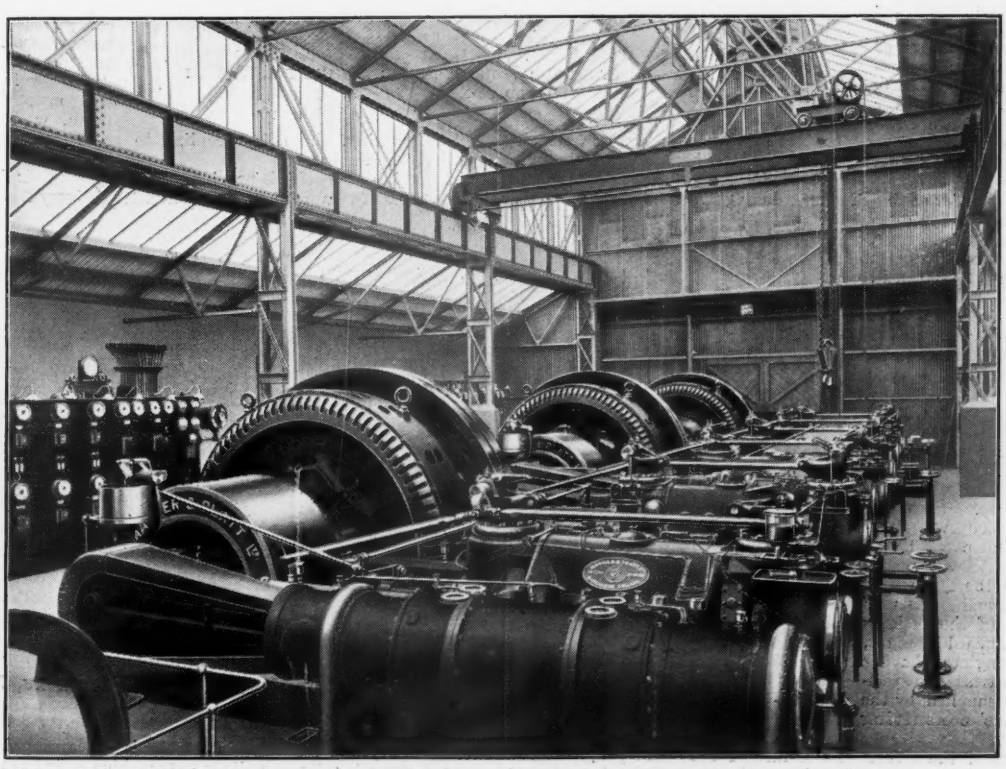

Fig. 2.—Three 500-b.h.p. Twin-Cylinder Körting Gas Engines and Three-Phase Alternators.

Platt's works. An engine of this type is working on coke-oven gas, and generating direct current for colliery work, and a second engine for this plant is being built, after some 18 months' working of the first engine. Similar engines are also being supplied to work on blast-furnace gas.

Premier Gas Engines.

THE PREMIER GAS ENGINE CO., LTD., of Sandiacre, were amongst the first of our gas-engine makers to build large gas engines, and their system of positive scavenging, devised many years ago and since improved from time to time, has always been

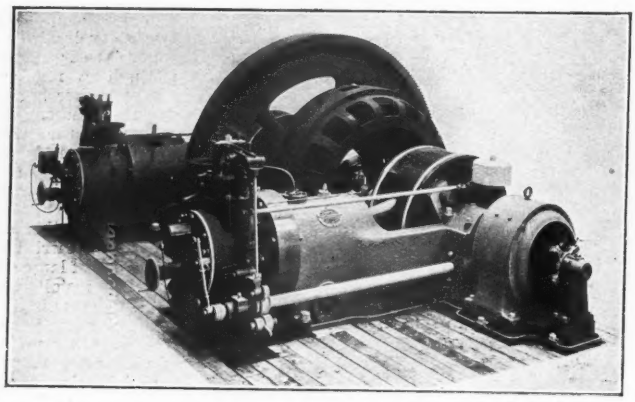

FIG. 3.—PREMIER TWIN ENGINE DRIVING ALTERNATOR.

a distinguishing feature of their engines. They have consistently preferred the horizontal type, considering that their multi-cylinder high-speed horizontal engines are superior to the vertical type and more reliable than the latter, while they occupy but little floor space, are well balanced, have forced lubrication, and are more accessible for cleaning and supervision, as all the parts can be inspected from the floor level.

These engines are made for all powers from 60 to 1,000 H.P., and the firm also make a line of low-speed tandem engines of single, twin and side-by-side patterns, with powers ranging from 400 to 2,500 H.P. The firm have designs ready for engines of 5,000 H.P.

A large number of their twin type engines have been exported to Japan, amongst other countries, and we illustrate in fig. 3 one of these engines driving an alternator, which is mounted on the crankshaft next the fly-wheel, between the two cylinders.

A four-cylinder engine of standard design is shown in fig. 4; this was recently shipped to the Hasami Gold Mines, Japan, and drives an alternator of 300 KW., running for 14 days at a time without a stop. The engine runs at 164 R.P.M. on Mond gas, and is of the "positive scavenger" type.

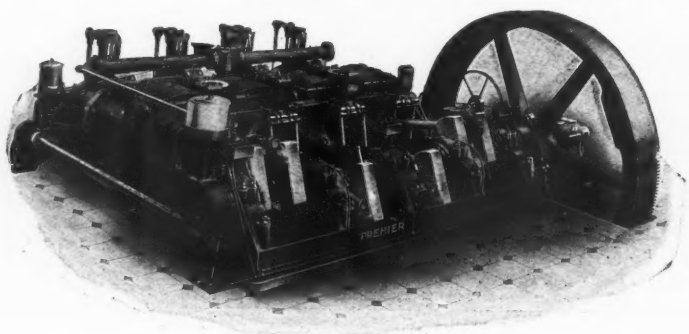

FIG. 4.—PREMIER STANDARD FOUR-CYLINDER ENGINE FOR HASAMI GOLD MINES.

Another view (fig. 5) shows the front end of a double-twin engine, one of two supplied to the Kankoku Gas-Electric Co., Japan, for driving 300-KW. alternators in parallel. A similar but smaller set is going to the Tokio Military Arsenal. This is not one of the maker's own standard designs, these engines having been constructed to specifications supplied by the purchasers' consulting engineers.

In view of the unfortunate failure of the municipal gas engine plant at Johannesburg, it is interesting to note that a 450-H.P. Premier gas engine has been installed at Groenfontein, at an elevation of 4,000 ft. above sea-level, fed from a gas producer made by the Power Gas Corporation, Ltd., and drives a 300-K.V.A. A.E.G. alternator. The producer is fed with bituminous coal. The engine has run with perfect satisfaction since its installation last summer, and should do much to remove the prejudice which has been set up in South Africa against gas engines by the Johannesburg fiasco.

The Mirrlees-Diesel Oil Engine.

Special interest attaches to the engines made by MESSRS. MIRRLEES, BICKERTON & DAY, LTD., of Hazel Grove, Stockport, seeing that the first Diesel engine made in this country was a Mirrlees-Diesel; that was 14 years ago, and the engine is still working. To ensure reliability, the Mirrlees-Watson Co., Ltd., ran several engines for two years in their own works, before they sold any, with the result that when they began to put them on the market they quickly developed a large demand and had to build new works, controlled by a separate company, for the sole purpose of making Mirrlees-Diesel oil engines.

The latter are all of the vertical type, with the valves in the cylinder covers. The engines are single-acting, and operate on the four-stroke cycle. They are made in sizes up to 1,000 H.P., mainly of the enclosed type, and of two classes—low-speed, 200-250 R.P.M., and high-speed, 400-450 R.P.M. All the enclosed engines have forced lubrication.

Fig. 6 shows a high-speed Mirrlees-Diesel engine as supplied to H.M.S. *Dreadnought*, and many other warships; these engines burn the same oil as the boilers are fired with, and their use enables the boilers to be shut down when in harbour, besides effecting a material saving.

A 500-H.P. four-cylinder enclosed engine supplied to the L.B. and S.C. Railway Co., to drive their new carriage works at Lancing, is shown in fig. 7. It is directly coupled to a dynamo. Similar engines of 500 and 750 H.P. have been made to numerous orders, both for home and abroad.

The air compressor of the Mirrlees-Diesel oil engine is of the two-stage type, and is direct driven from the engine crankshaft, being mounted on an extension of the engine bedplate. In this type of compressor the only bearings are the connecting-rod bottom and top end brasses, and suitable provision is made for taking up any wear that may occur. This form of compressor is a great improvement on the link-driven type of machine, in which there are some eight to ten wearing joints, which are liable to cause trouble. Owing to the position of the compressor, the parts are all readily accessible for inspection or repair, and the valves may be changed with a minimum expenditure of time and trouble.

The valves are of the makers' improved type, which ensures silent running, the noise peculiar to other compressors being entirely eliminated.

A special intercooler is provided for cooling the air between the two stages of compression, as well as after delivery from the high-

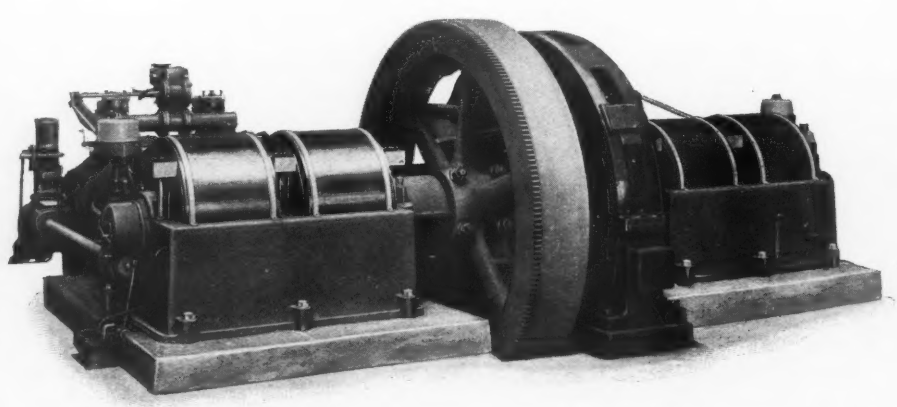

FIG. 5.—PREMIER DOUBLE-TWIN ENGINE DRIVING 300-KW. ALTERNATOR AT KANKOKU, JAPAN.

pressure cylinder, and this intercooler is also arranged so as to act as a separator for any oil or water which may have been carried over with the air.

The fuel pump is of special design, and is provided with a separate plunger and valves for each cylinder of the engine; this arrangement has the advantage that under all conditions of working each cylinder will take an equal share of the load on the engine, whereas in the single-plunger type of pump, as often fitted, this equal distribution can only be arranged for one particular load, and will not hold good over a varying range.

A special safety device is fitted to the starting cylinders of the engine, which automatically by-passes the fuel from the cylinder on starting up, thus preventing any accumulation of oil in the fuel valve casing of that cylinder if the attendant does not put the starting handle into the running position at once. This safety gear is also arranged so that any of the cylinders may be cut out as desired when the engine is running on lighter loads.

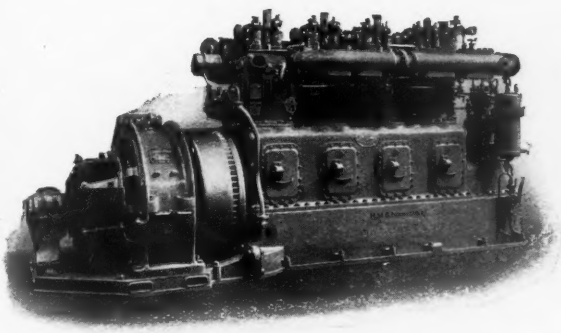

Fig. 6.—Mirrlees-Diesel High-Speed Engine and Dynamo for War Vessels.

All valves are provided with removable seats, and as spare valves and seats for all the main valves are included in the engine equipment, the grinding-in of the valves can be carried out at any convenient time, and not necessarily when the engine is stopped. The actual changing of the valves and seats can be performed in a few minutes. In order to facilitate the changing of the exhaust valve, the valve lever is made in two parts, so arranged that by removing one bolt only the lever may be swung back, thus allowing the exhaust valve to be withdrawn without disassembling the remainder of the valve gear.

The gear wheels for driving the vertical and cam shafts are enclosed in oil-tight casings, and run in an oil-bath. The vertical shaft is cased in by a polished steel tube, with oil-tight glands at the top and bottom; this tube provides a passage for oil from the upper to the lower gear casings, and also acts as a guard, obviating any danger of the attendant's clothing being caught by the revolving shaft.

The cylinder covers are made in two pieces, a loose top being provided, so that any accumulation of sand or dirt which might collect in the water spaces can be thoroughly cleaned out. The cylinder liner can be easily withdrawn from the column, and the jacket space in the main cylinder cleaned if this becomes necessary. This feature of accessibility has proved of great advantage in cases where the water used contained a large amount of sediment.

Orders for Mirrlees-Diesel engines of over 5,000 B.H.P. in all were received between December 1st and February 29th, 1912, including several of 500 and 750 H.P. for driving electrical generators.

Willans-Diesel Oil Engines.

Amongst the earliest to take up the manufacture of the Diesel engine in England—having made certain sizes for the Diesel Engine Co. for some years—Messrs. Willans & Robinson, Ltd., of Rugby, have given special attention to the development of this branch of their business, and have supplied a large number of engines of powers up to 450 B.H.P., and running at speeds up to 250 R.P.M. The great majority of these have been required for driving electric generators, and many of them have gone abroad. The Willans-Diesel engine is of the well-tried four-cycle type, presenting no novel features save in the details of its construction; the makers' policy has been to adopt an engine of excellent general design, and to apply to it the many improvements in details and methods of manufacture which they have evolved during the years they have now been manufacturing this type of engine.

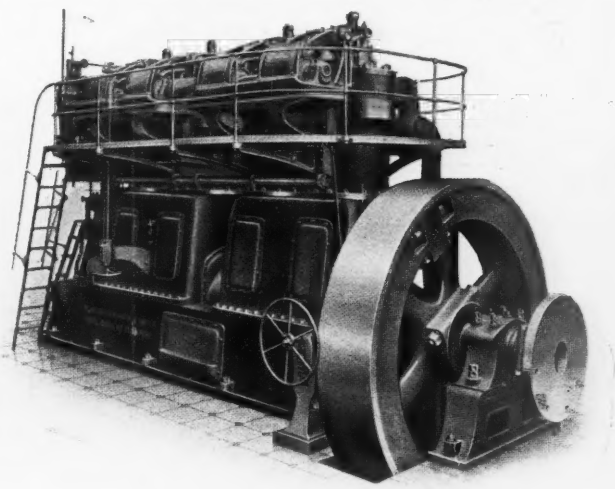

Fig. 7.—Mirrlees-Diesel 500-H.P. Four-cylinder Enclosed Oil Engine.

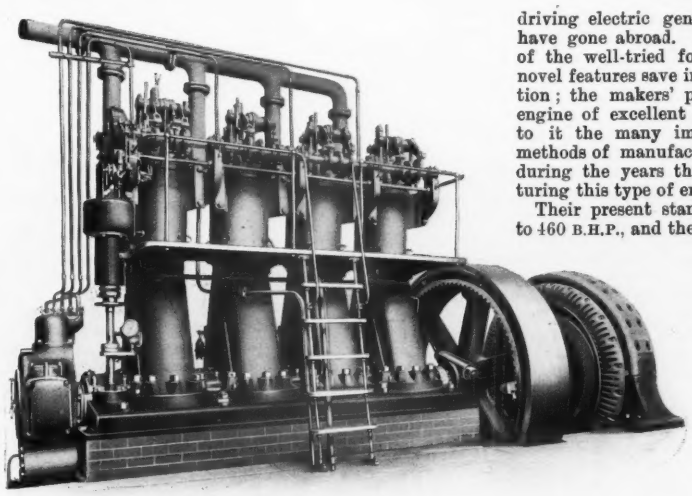

Fig. 8.—Willans-Diesel Engine for South America.

Their present standard sizes range from 50 up to 460 B.H.P., and their engines have been installed and are being manufactured for driving all classes of machinery, either as isolated units or in power houses containing other plant, in many parts of the world, and in the hands of many classes of drivers.

Fig. 8 shows one of four 280-B.H.P. engines supplied to the Alianza Co. and the Rosario Nitrate Co.'s Works in South America, coupled to alternators; and fig. 9 shows a Willans 225-B.H.P. engine driving a dynamo at the British Uralite Co.s. works in Gravesend.

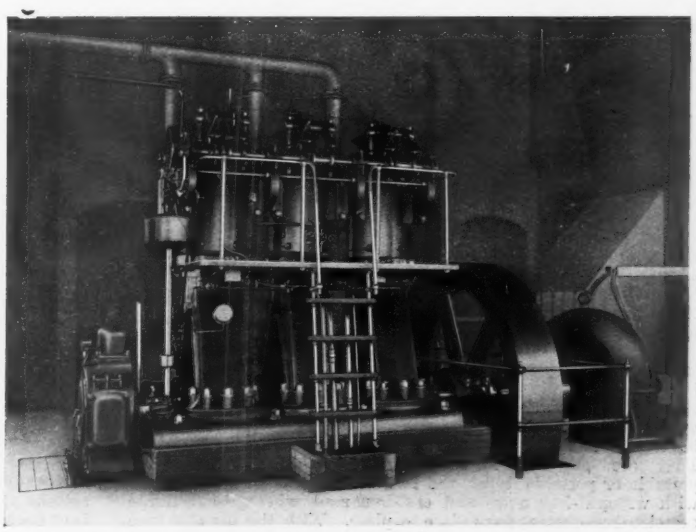

Fig. 9.—Willans-Diesel Plant, British Uralite Co.'s Works.

In the manufacture of these engines, the whole of the parts are made to jigs, thus ensuring strict interchangeability of all similar parts of the same size of engine, and enabling all spare parts to be ordered with the certainty that they will fit the place for which they are intended, without any adjustment on the part of the purchaser—a feature sure to be appreciated by the users of the engines, especially those abroad.

The Turner Oil Engines.

These engines are made by MESSRS. E. R. & F. TURNER, of Ipswich, in a range of sizes from 2½ to 25 B.H.P., and owing to their rigid design and accurate balancing, are specially adapted for electric driving. In the smaller sizes they

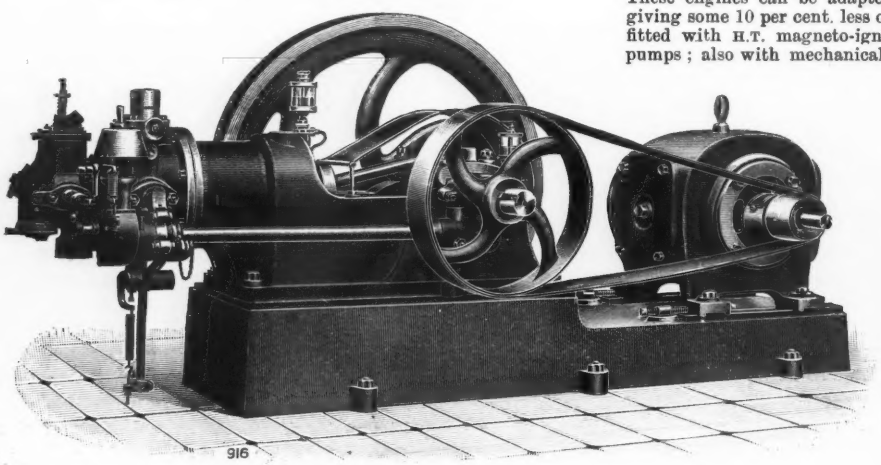

FIG. 10.—TURNER HORIZONTAL OIL ENGINE DRIVING DYNAMO.

are supplied, if required, with an extended base-plate for the dynamo, as shown in fig. 10. The larger sizes are fitted with two extra-heavy fly-wheels when used for electric driving, the smaller sizes being also fitted with two fly-wheels if used for "direct" driving, and balanced crankshafts are provided in all cases. The engines will run on any ordinary lamp oils, and on good-class crude oils, but are not recommended for use with heavy residual or refuse oils. The fuel consumption is exceptionally low, not exceeding ·6 pint per B.H.P.-hr. in the small sizes, or ·5 pint in the largest, when working on average loads. A starting lamp, supplied with each engine, is only used for a few minutes to heat the vaporiser and ignition tube when starting up; the necessary temperature for vaporising and ignition is afterwards automatically maintained, whether running on full load, or with no load whatever on the engine.

An air throttle is fitted, which is shut at starting and open when running. No adjustment is required when running at any load. The main and cam-shaft bearings of the 7-B.H.P. size and upwards are fitted with continuous oiling rings, while in all sizes the crank-pin bearings are positively lubricated by means of a specially-designed oil ring of the centrifugal type. Valve rollers, pins, lever gudgeons, &c., are hardened and ground exactly to size. For the foregoing reasons, these engines may be depended upon to run for many years without appreciable wear or replacement of parts. They are suitable for all power purposes, being successfully employed in driving grinding mills of all descriptions, chaff-cutters, saw-benches and wood-working machines, pumps both gear and belt-driven, &c. They are supplied in semi-portable or portable types, the former having a wooden carriage with wrought-iron axles and cast-iron road wheels, to facilitate occasional movement from place to place. With the portable type a wrought-iron carriage and road wheels are provided, a water tank being attached to the under side, and circulation and cooling are effected by means of a pump and surface trays. A current of cold air induced by the outgoing exhaust gases is passed through the latter, effectively cooling the water returning to the tank

Parsons Motors.

The PARSONS MOTOR CO., LTD., of Southampton, are best known for the numerous marine petrol engine installations which they have carried out.

The Parsons engine has, however, also been adapted for stationary use, and an example of petrol-engine and dynamo work—a 28-H.P. generating set—was illustrated and described in our issue of December 15th last.

It is sufficient to say that long experience has enabled the company to develop a thoroughly reliable engine, built in standard series, having 4½ in. × 6 in., 6½ in. × 8 in., and 9 in. × 12 in. cylinders, giving a complete range of sizes between 7 H.P. and 180 H.P., at speeds of 750, 550 and 450 R.P.M. per series respectively These engines can be adapted for using either petrol or paraffin, giving some 10 per cent. less output with the latter fuel, and are fitted with H.T. magneto-ignition, and cooling water circulating pumps; also with mechanically-operated main valves arranged on the company's patented concentric principle, with a nickel steel exhaust valve in the centre of a hollow cast-iron inlet valve.

The company have already achieved considerable success with their engines abroad, there being, we understand, very few countries in which examples of their work cannot be found.

Reavell Oil Engines.

MESSRS. REAVELL & CO., LTD., of Ranelagh Works, Ipswich, whose quadruplex type compressors are so well-known, have for several years turned their attention to the manufacture of oil engines. The engines which they build are of the vertical high-speed type, and in designing and constructing them they have made it their aim to produce machines which shall be suitable for continuous and heavy service for industrial purposes, so that the engines are specially designed for such conditions, and are not adaptations of the "motor-boat" or "motor-car" type arranged for other purposes.

We give an illustration, fig. 11, of one of their two-cylinder engines directly coupled to a dynamo, which is both extremely neat and substantial in appearance. The engine illustrated is of the 10-B.H.P.

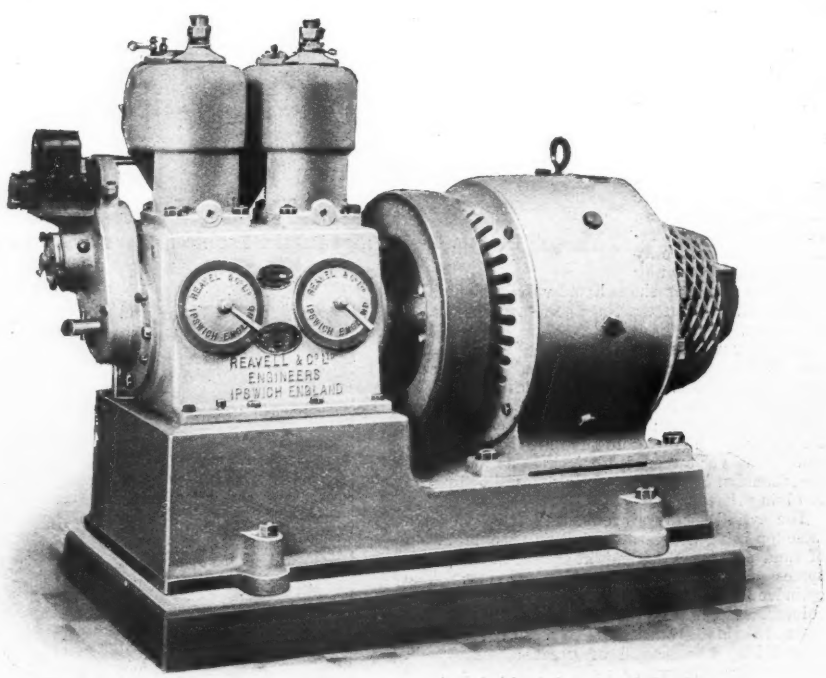

FIG. 11.—REAVELL 10-H.P. OIL-ELECTRIC SET.

size, and the speed is 800 R.P.M. This speed, while being very suitable for driving dynamos, centrifugal pumps, fans and so on, is at the same time not excessive, and conduces to long life of the engine and small wear of the working parts. The lubrication is arranged on the splash principle, and is therefore automatic, the connecting rods dipping at each revolution into the bath of oil in the crankcase and splashing it to the various bearings.

The vaporiser, arranged behind the engine, is of Messrs. Reavell's

own design, and is suitable for using either petrol, ordinary paraffin or lamp oil. The engine is started by using a little petrol, upon which it is run for a few minutes until the vaporiser is sufficiently heated, when the paraffin supply can be turned on. It can also be started on paraffin by heating the vaporiser with a blow lamp, if petrol is not available. All the working parts are interchangeable.

Messrs. Reavell supplied, in addition to other engines, 12 of the size illustrated to one of the large Indian railways last year, and they have a repeat order going through their works at the present moment for 10 more engines of the same size, destined for this railway.

The Kelvin Engine.

These engines operate on the four-cycle principle, and are built for both petrol and paraffin fuel.

An interesting constructional feature is the use of ball journal bearings, leading to a reduced length of engine. Every important

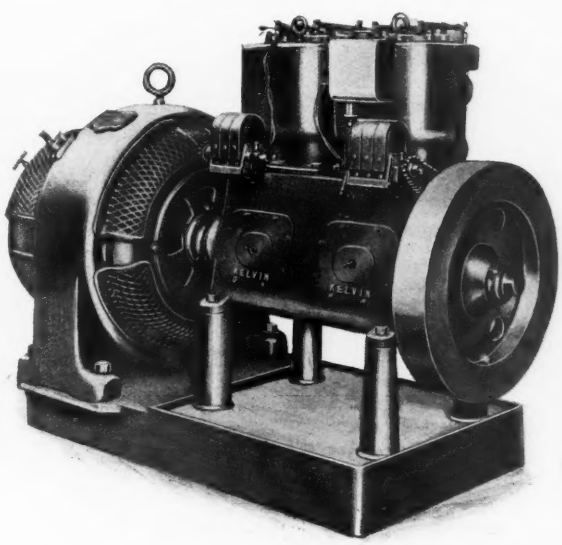

Fig. 12.—Kelvin Electric Lighting Set.

part is immediately accessible without disturbing other parts; the crankshaft can be withdrawn at either end, and the piston and connecting rod can be removed without disturbing the crankshaft or cylinder. In the larger sizes, the engines are fitted with the Bergius starting device, by means of which starting can be carried out without the usual vigorous cranking.

Either L.T. or H.T. magneto ignition is fitted, and a plunger pump provides cooling water circulation to the cylinder jackets. The engine governing, in conjunction with the special dynamo windings employed in the generating sets, gives a practically steady voltage from no-load to full-load.

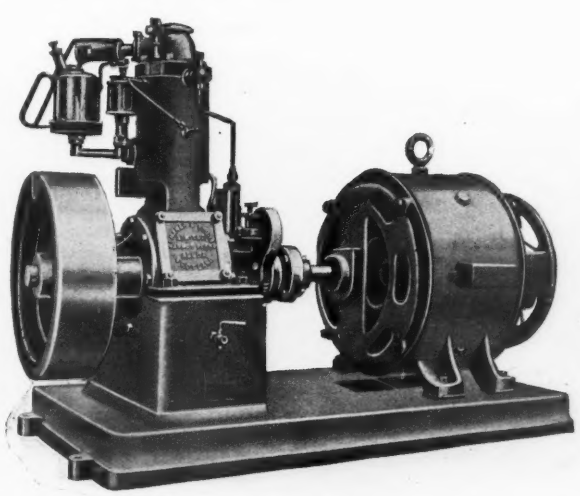

Fig. 13.—Marmot Two-Cycle Engine and Dynamo.

The Kelvin generating sets are made in sizes ranging from 3 kw. at 850 r.p.m. to 32 kw. at 410 r.p.m.; they are also built in stationary or portable form, and a very large number have recently been supplied for farm work, ship-yards, cinematograph work, &c.

The engine is entirely made at the Kelvin Works, Dobbies Loan, Glasgow, and some idea of its success can be gathered from the fact that the works have been trebled in size within the last three years, 900 engines having been turned out within the last 12 months. The sole selling agents for these generating sets are Messrs. Fyfe, Wilson & Co., of 145, Bath Street, Glasgow.

The Marmot Heavy-Oil Engine Set.

We illustrate in fig. 13 a small electric lighting set made by Messrs. Sharer & Young, Ltd., of Marmot Works, Alloa, the engine being designed to run on any fuel between ordinary lamp oil and crude oil—specific gravity ·79 to ·89.

The set shown is of 3¾ b.h.p. at 900 r.p.m.; it works on the two-stroke cycle, and is provided with fuel pumps giving a positive feed to each cylinder, while the ignition is automatic after starting, that operation being carried out by heating the ignition chamber by means of an oil burner working under air pressure and using the same fuel as the engine.

It is of interest to note that larger engines of 20 h.p. and more have self-starters fitted, working by compressed air—a compressor and air tank being supplied with the engine.

The Marmot engines are solidly made, with gun-metal bearings and phosphor-bronze bushes; inspection doors are fitted to the crank-case, and spare parts which might be required quickly, such as an ignition chamber, piston rings, paraffin strainer, &c., are supplied with each set.

Electric Lighting Sets by Chas. Price & Son.

We illustrate in fig. 15, page 630, a new type medium-sized generating set made by Messrs. Charles Price & Son, Broadheath, near Manchester, in 1, 2, 3, 4 and 6-cylinder units, of from 10 h.p. to 75 h.p. The engine is built to run on petrol or petroleum, a clear and odourless exhaust being obtained when using either fuel, and the speed is 700-750 r.p.m.

The cam-shaft and valve-operating mechanism are situated above the cylinder, the valve tappets being adjustable for wear; the valves are contained in cast-iron cases, and are held in position by forged clips. The cams are hardened, and operate the valve-rocking lever through hardened rollers running on hardened pins; half-compression gear is fitted to ease the starting. Ignition is effected by H.T. magneto, with a supplementary system of synchronised coil and accumulator.

Oil is forced into the crankshaft bearings by a rotary pump operated by the vertical shaft at the front of the engine, and emergency sight-feed lubricators are also fitted. All the bearings have been arranged to avoid oil leakage, and the plant is exceptionally cleanly in working.

Cooling water is circulated by a gear-pattern pump, and the system is arranged to clear itself through one cock in frosty weather.

The governor is adjustable, and is specially sensitive, to secure the close speed control necessary on this class of work.

A large inspection door is fitted to the crank-case, through which the connecting-rod big-ends and crankshaft bearings can be adjusted for wear when necessary.

The set is adapted for accumulator charging or lighting direct, and runs very steadily and almost noiselessly, so that it can be installed in the basement of a building, where an outside power house is not available. Using fuel at 6¼d. per gallon, the total cost per unit is stated to be approximately 1¼d.

We also illustrate in fig. 14 one of this firm's high-speed lighting

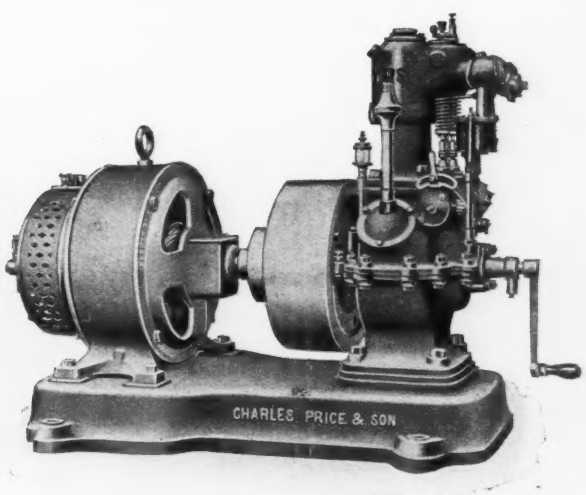

Fig. 14.—Price's 1·5-kw. Lighting Set.

sets made in single, double and four-cylinder units from 2 to 26 b.h.p. Our view shows one of their 1·5 kw. paraffin plants, running at 1,000 r.p.m., with accumulator ignition. The engine valves are all on one side, and the cams are solid with the shaft, which is case-hardened, as is also the whole of the valve mechanism. The cam

shaft can be withdrawn easily, and is driven by a spiral gear as follows:—

Between the wheel on the crankshaft and that on the camshaft is fixed a transverse gear shaft, driving at one end the magneto and at the other the governor, which is coupled directly to the throttle, and cuts off at between 1,000 and 1,100 R.P.M. Adjustment for wear is provided on the crankshaft bearings, the connecting rod big-end and the valve mechanism, and by removing a cover the top of the piston can be cleaned.

The lubrication is automatic, and access to the crank-case is given by a large inspection door.

With the spirit engine a float-feed carburetter is substituted for the gas and air regulator, and an aluminium jacket is arranged round the exhaust outlet to supply the necessary warm air to the carburetter.

The cylinders are cast separately, with plugs to allow for the

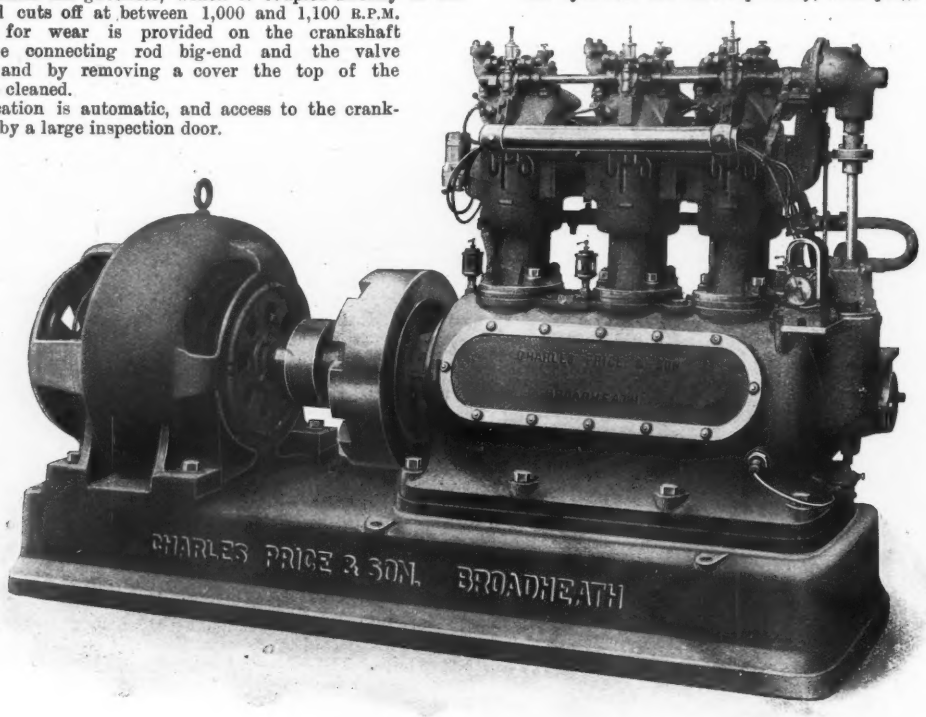

FIG. 15.—THREE-CYLINDER LIGHTING SET BY CHAS. PRICE & SON.

The cylinders are cast singly or in pairs, and the inlet passage has a common central port, while the exhausts for each cylinder have individual ports. The upper half of the crank-case carries all the bearings. The bearing caps are held by bolts passing through the top flange of the crank-case, and by this means the downward stresses are transmitted to the main frame of the crank-case.

cleaning of all parts of the water jacket; the cylinder head forms a plug, which, when removed, allows of the piston and connecting rod being withdrawn without disturbing the cylinders.

Forced water circulation for cylinder cooling and forced lubrication are provided, a gear-driven pump being employed in each case. The speed is governed by a throttle valve, similar in

Gardner Electric Lighting Sets.

The Gardner engines and electric generating sets require little introduction to the engineer, as they have for a good many years found favour both for land and marine uses.

We illustrate in fig. 16 a four-cylinder high-speed engine set by MESSRS. GARDNER, of Patricroft, Manchester, one

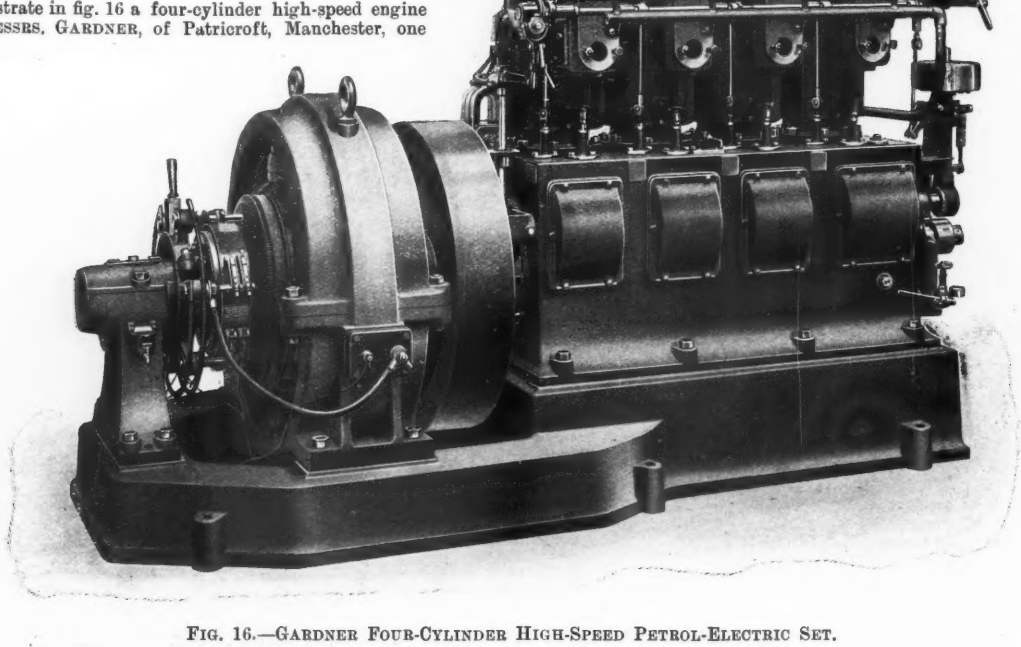

FIG. 16.—GARDNER FOUR-CYLINDER HIGH-SPEED PETROL-ELECTRIC SET.

of a type originally developed for launch and vehicle work, using petrol. The engine referred to can be adapted for use with either town or producer gas or petrol, its outputs in the three cases being 56, 43 and 54 B.H.P. respectively at 600 R.P.M.; engines of this class are supplied up to 130 B.H.P.

type to that used on high-speed steam engines, on the mixture inlet pipe; the governor is provided with an adjusting screw to set the speed to the value desired.

Starting is effected by means of a clutched handle on the crankshaft, and to facilitate this operation the compression is relieved in each

cylinder by throwing over a small lever, which brings into action auxiliary cams acting on the exhaust valves; L.T. magneto ignition is usually fitted.

Gardner engines for use with petroleum, and similar in design to the foregoing, in sizes up to six cylinders and 110 B.H.P., are also made by this firm for a variety of purposes. We illustrate in fig. 17 a little 1¼-B.H.P. engine and dynamo, with extended bedplate,

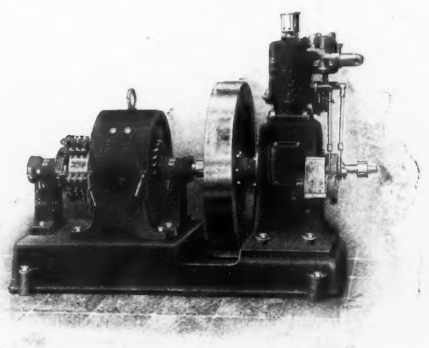

Fig. 17.—Gardner 1¼-B.H.P. Electric Lighting Set.

suitable for country house lighting and similar work, these engines being arranged, as required, for working with petrol, oil or gas, at medium speeds, ranging from 700-750 R.P.M. in the 1¼-B.H.P. size, to 370-400 R.P.M. in the 7-8-B.H.P. size.

The Fielding Gas Engine.

We illustrate herewith a typical double-cylinder side-by-side gas engine and suction gas producer made by Messrs. Fielding & Platt, of Gloucester, in sizes ranging from 110 to 290 B.H.P.

Constructively, it will be noticed that the engine is strongly built, one massive casting carrying the bearings and cylinders. A system of graduated governing is fitted, the governor being of the high-speed rotary ball pattern, adjustable as to speed while running. A special magneto ignition developed by the firm is fitted, with a simple form of sparking plug; forced lubrication to the crank-pins and pistons, and ring bearing lubrication, are other features of interest.

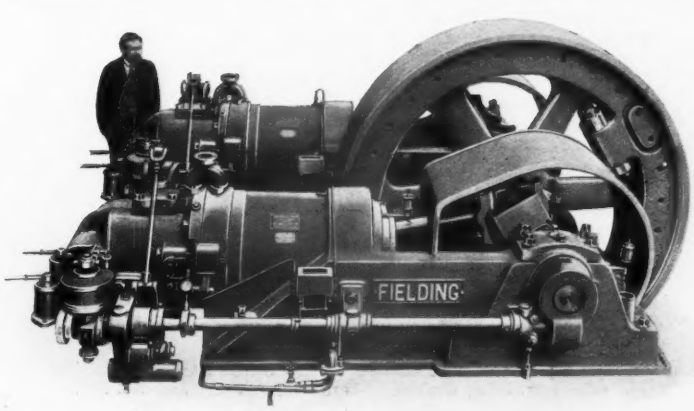

Fig. 19.—Fielding Side-by-side Gas Engine.

In the producer plant a patented device of the firm is employed for introducing steam to the furnace. The air and steam are admitted into the generator at the base of the fire from a central orifice beneath the grate, the air and sprayed water passing through a hollow base-plate which carries the fire and entering, as steam, equally all round the base of the fire.

Special claims in the matter of efficiency are advanced for this arrangement of automatic control, which obviates the use of the usual internal steam boiler.

The Fielding producer plant is exceedingly compact, and it is interesting to note that, at the Royal Agricultural Show trials in 1906, it proved to be one of the best plants entered.

Silvertown Petrol-Electric Sets.

The "Silvertown" petrol-electric generating sets made by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, are specially designed for private house, hotel and ship lighting and power. The set consists of a dynamo directly coupled to a medium-speed vertical type petrol engine, both being mounted on a common bed-plate.

The dynamo is a standard Silvertown machine, and is supplied shunt or compound wound, in either open, protected or ventilated enclosed type. The engine has one, two or more cylinders, according to the output required. The cylinders are water-cooled in the smaller sizes on the thermo-siphon principle; in the larger engines a circulating pump driven from the crankshaft is provided for this purpose.

The crankshaft, connecting rods and cams are solid forged of high-grade steel, the cams being case-hardened. The engine is fitted with interchangeable valves and adjustable tappet mechanism, and adjustable crank bearings are provided. A large inspection door is fitted, and all joints are truly faced, special precautions being taken to prevent the oil from leaking out of the crank chamber.

Ignition is effected by accumulator and coil or magneto, and dual ignition can be supplied if required. Efficient automatic lubrication is provided for the piston and all bearings.

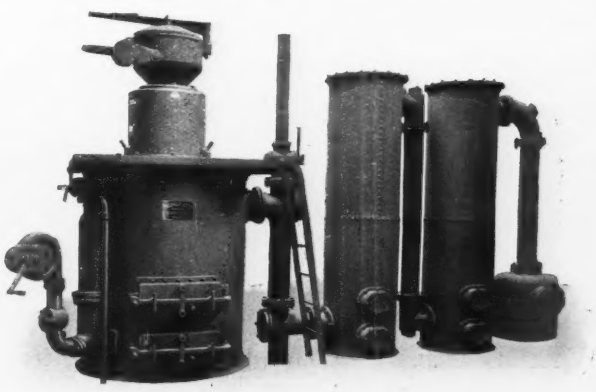

Fig. 18.—Fielding Suction Producer Plant.

The carburettor is arranged with throttles as close as possible to the valves of the engine, and a governor is fitted which controls the speed within 5 per cent.

If desired these engines can be run with paraffin as fuel, in which case a vaporiser is fitted in place of the carburetter.

The G.H.H. Four-Cycle Engine.

The firm of Gutehoffnungshutte, of Oberhausen, is one of the largest engineering concerns of Rheinland, employing 25,000 workmen, and, mining its own coal and iron ore, turns out every description of heavy steel work, castings bridges, boilers and engines. We illustrate on page 632 one of its large gas engines, of which a considerable number have been turned out during the past 10 years, for driving blowers and electric generators. These have been mainly of the two-cycle type, but the one here shown works on the four-stroke cycle, and is double-acting, with tandem cylinders. The frame is cast in one piece, and rests over its whole length on the foundation, carrying the slide for the cross-head and the two main bearings for the crank-shaft. The piston-rods are supported at each end and between the cylinders, so that the cylinder flanges and the stuffing-boxes are relieved of the weight of the rods and

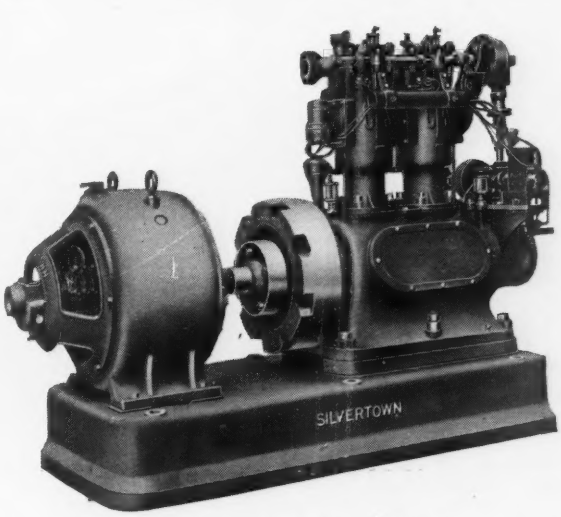

Fig. 20.—Silvertown Petrol-Electric Set.

piston, and the rods are divided into two detachable parts at the middle guide. The cylinder covers can be drawn forward on the piston rods to enable the pistons and the interior of the cylinders to be inspected and cleaned, without removing any other parts. The cylinder is cast in one piece with the jacket, which can be inspected and cleaned through hand-holes. The inlet and exhaust valves are

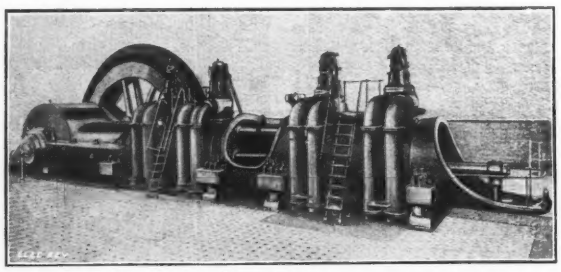

FIG. 21.—G.H.H. DOUBLE-ACTING FOUR-CYCLE TANDEM 1,500-H.P. GAS ENGINE.

arranged respectively above and below the cylinder, giving a plain and symmetrical casting free from internal strains; they are operated by eccentrics and roller levers from a lay shaft driven by worm gear running in oil. The mixing valve, which controls the admission of both gas and air, is arranged on the same axis as the admission valve, and is of special design; as shown in the sectional view, it is four-seated, the gas valve seats being conical, and the air ports cylindrical, so that the air and gas are intimately mixed before entering the cylinder. The action of the governor can be readily understood from the section, which shows the main eccentric rod above, and the governor rod below; the latter, by means of the wedge-shaped piece resting on the mixing-valve lever, varies the lift of the latter, and the opening of the gas and air ports. The valve can easily be removed for cleaning, as it comes away with the bonnet. Throttle valves are provided in the gas and air supply pipes, to enable the composition of the mixture to be regulated in spite of considerable variations in the pressure in the pipes. The exhaust valves are of the disk type and work in water-cooled chambers.

Ignition is effected by direct current at 60 to 70 volts, with tappet interrupters inside the cylinder. At each side of the cylinder are two igniters, each provided with its own sparking plug. A contact disk controls the timing, and the interruption is effected by an electromagnet operated by the ignition current.

The stuffing boxes in the cylinder covers are packed with cast-iron rings, allowing free movement of the piston rod in all directions. Forced lubrication is provided to all important working parts. The cylinders, covers, pistons and piston-rods are all water-cooled.

The engine illustrated, which is one of a large number installed at the Eisenhütte Oberhausen, using blast-furnace gas, is one of the latest type, and one of its most noteworthy features is the simplicity of the valve gear, which indeed is no more complicated than that of a steam engine of similar type. Four of the G.H.H. engines of 600 B.H.P. each have been supplied to the Park Gate Iron and Steel Co., of Rotherham, and three of 1,000 B.H.P. each to the Barrow Haematite Steel Co., all for driving blowers.

Hick-Diesel Oil Engines.

MESSRS. HICK, HARGREAVES & CO., of Bolton, have recently commenced the manufacture of Diesel oil engines, which are being placed on the market by Hick-Diesel Oil Engines, Ltd., of 11, Queen Victoria Street, E.C. We understand that the original Diesel designs are being followed and that the firm are prepared to build in outputs of from 80 to 1,000 B.H.P.

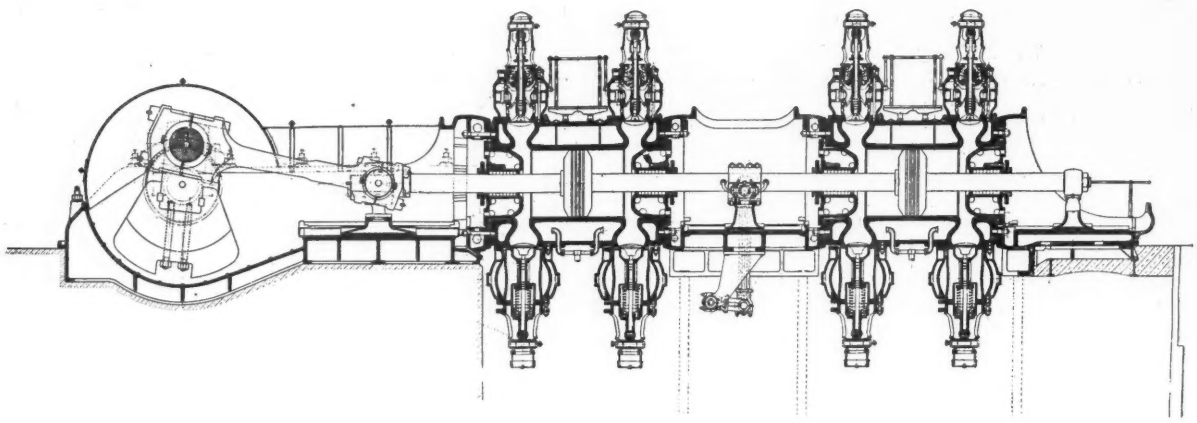

FIG. 22.—LONGITUDINAL SECTION OF G.H.H. ENGINE.

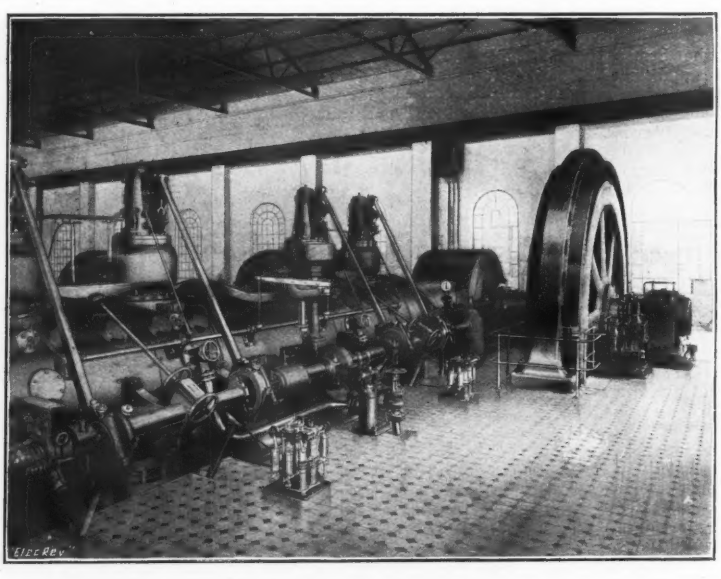

FIG. 23.—G.H.H. ENGINE, SHOWING VALVE GEAR.

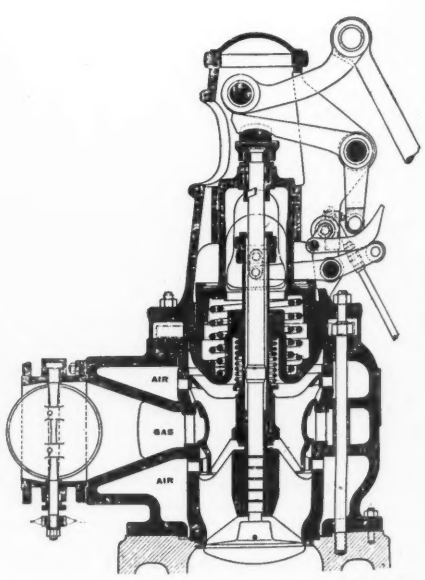

FIG. 24.—SECTION OF AIR AND GAS ADMISSION VALVES OF G.H.H. ENGINE.

As Messrs. Hick, Hargreaves have for so many years been known for the excellent Corliss and other engines which they have supplied, this new departure will be watched with considerable interest.

The Ruston "Complete Combustion" Crude-Oil Engine.

A very successful engine working on crude and residual oils is made by Messrs. Ruston, Proctor & Co, Ltd., of Lincoln. Its success is due, to a large extent, to the simplicity of the design, and to the fact that long runs can be made without cleaning, even when running on the lowest grades of fuel oil. The engine works with great economy on all loads, and by reason of its close

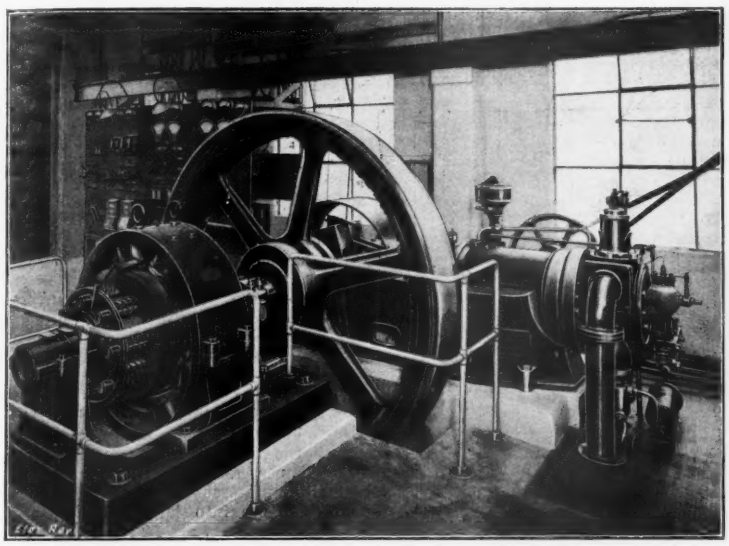

Fig. 25.—Ruston 65-b.h.p. Crude-Oil Engine and Dynamo.

governing is eminently suitable for dynamo driving, the variation in speed from no load to full load not exceeding approximately 4 per cent.

This oil engine is well adapted for power installations in close proximity to dwelling houses, there being no smell, and when suitable arrangements are made, the exhaust can be rendered almost silent. The illustration, fig. 25, shows a typical installation, the engine being of 65 b.h.p. directly coupled to a 40-kw. dynamo.

The generating costs are remarkably low for a plant of this size and simplicity. With fuel oil at 43s. per ton, the total cost per unit, including fuel oil, interest, depreciation and repairs, is approximately ½d. per Board of Trade unit, the consumption being ½-lb. of oil per b.h.p.-hour.

It will thus be seen that the engine possesses all the necessary features to make it suitable for electricity works, country house lighting and general industrial work, and it has been successfully adopted for such purposes not only in this country, but in Russia, Italy, Roumania, India, East Indies, Australia, and other parts of the world. The Ruston "Complete Combustion" oil engine works upon a cycle similar to that of the Diesel engine, the difference being that in the latter the charge is forced into the cylinder by compressed air and ignited solely by the temperature of compression, whilst in the Ruston engine the charge is pumped into the cylinder in a highly atomised state, and the ignition is effected jointly by the temperature of compression and of the combustion chamber walls. The working temperature of the engine is controlled by a water snifting valve.

The governor is of the centrifugal type, and varies the quantity of oil delivered to the atomiser according to the load upon the engine.

The recent improvements introduced into the Ruston gas engines have been in the direction of increasing their durability and reducing the attention required when running the engine. The scantlings adopted are based on a generous scale, and no pains are spared to make these engines first-class in every way. All the larger sizes are governed on the throttle principle, the device adopted being a simple and highly efficient patent held by the firm. These engines are now to be found working in nearly all parts of the world, providing power for various purposes.

In addition to anthracite, coke and charcoal suction-gas producers, the company have now developed their patent wood producer, which will take any kind of wood refuse, and is specially arranged so that it can run continuously for long periods, the patent cleaning devices being such that whatever cleaning is required can be done easily, without any stoppage. With this producer both lignite and peat can be used, and even sawdust alone. Such plants have been installed at, or are on order for, Grimsby, Hull, Market Rasen, London and other places, for use in sawmills on wood refuse.

William Beardmore & Co., Ltd.

The Oechelhäuser engine, invented by Dr. Wilhelm von Oechelhäuser and Prof. Hugh Junkers as far back as 1892, has passed through numerous modifications in arriving at its present stage as manufactured by Messrs. William Beardmore & Co, Ltd., of Glasgow. The essential features distinguishing it from all other prime movers are retained, such as the two mutually-opposed pistons working in one cylinder open at the ends, with a common combustion chamber in the middle. The outlet and inlet ports are also retained, and the balanced action of the engine is preserved. On the other hand, the disadvantages of excessive floor space, of expensive construction, of limited speed and of low mechanical efficiency have all been overcome, whilst the engine details have been greatly simplified.

The overall length has been reduced by as much as 25 to 35 per cent., depending upon the position of the charging pump at the end or side of the engine. In this design the production of cylinder-liners and combustion chamber in one continuous piece of metal is rendered possible; the joints subjected to high pressure and temperature are thus avoided, and the liner may be withdrawn from the casings without further dismantling of the engine.

Economy in construction has also been effected by this design, and a decided reduction has been made in the weight of the whole engine. The triple-throw crankshaft is now made in one piece from fluid compressed steel, instead of being built up as formerly. The width, weight and manufacturing cost of this important part are thus considerably reduced, and a consequent reduction follows in the adjacent parts. The length and weight of the side rods and back crosshead are also reduced largely in the new design, and by this means the speed of rotation of the engine may be safely increased without stress reversal in the rods.

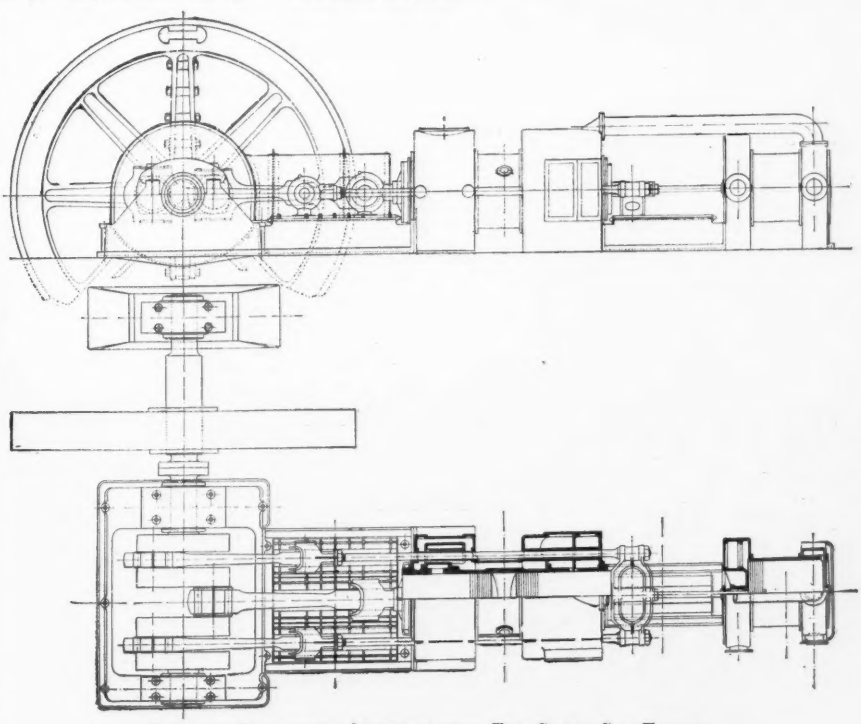

Fig. 26.—Beardmore-Oechelhauser Two-Cycle Gas Engine.

In former designs the frictional resistances of the heavy reciprocating masses, together with defects in the mechanical arrangements attached to the charging pumps, were responsible for the low mechanical efficiency obtained with this engine. Alterations made in these parts have enabled the makers to reduce the proportion of indicated work absorbed in the pumps from 20 per cent. down to 7 per cent. of the total quantity developed in the cylinder at full load. Further modifications in the direction of simplicity consist in the abolition of the side shaft with its gears, cams, &c., the

governor drive, ignition timing, &c., now being taken directly off the crankshaft. The general arrangement of the engine, with the pump at the end, is shown in fig. 26, page 633. The following material advantages result from the above disposition of the engine:—

For large powers the Oechelhäuser design now occupies about 20 per cent. less area than that taken up by four-cycle engines.

The engine is practically balanced, due to the mutually-opposed pistons and their moving connections, and a higher speed may safely be adopted without danger of vibration or rocking.

All mechanically-operated valves are absent, with their attendant eccentrics, links and levers, wear and tear, power absorption, and cooling devices.

There are no working parts below the floor. High-pressure piston rod packings are eliminated, on account of the open-ended cylinder employed. An ideal combustion chamber is obtained, and the surface exposed to cooling action is decidedly less than in other types, thus ensuring thermal efficiency.

To gain access to the interior of the working cylinder it is only necessary to remove the back piston, an operation requiring not more than from 30 to 40 minutes.

These engines have been built in different sizes from 400 H.P. up to 2,000 H.P. in a single cylinder, and are employed in the generation of electrical energy, and for all kinds of heavy duty.

Recently the principle has been extended to the tandem type with marked advantage, and a number of engines are being built for marine work of the vertical tandem type, which are about to be installed in sea-going vessels.

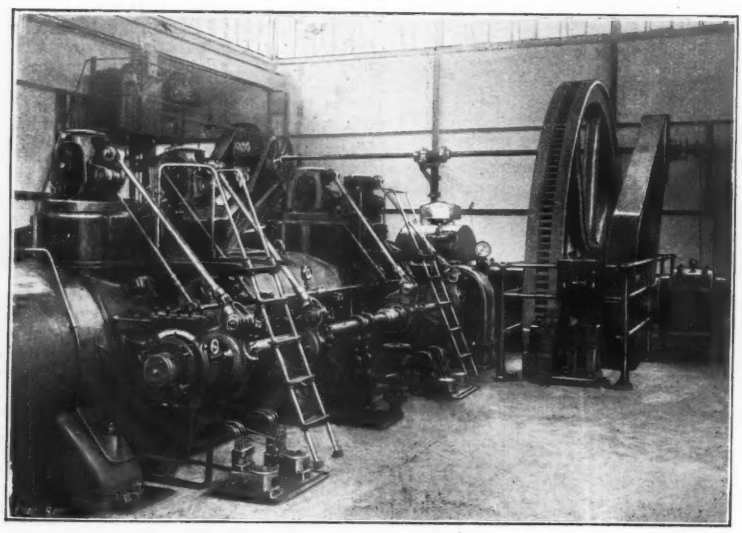

FIG. 27.—LILLESHALL-NUREMBERG 600-B.H.P. GAS ENGINE.

The Lilleshall Co.'s Engines.

THE LILLESHALL CO., LTD., of Oakengates, build the Nuremberg gas engine under licence in this country, and last year started a 600-B.H.P. gas-driven compressor at the works of the United Alkali Co., Widnes, as well as a 1,000-KW. gas alternator at a chemical works in the Birmingham district. The accompanying illustration shows the appearance of the engine, which is of the double-acting tandem type, and is constructed in single-crank units up to 3,000 B.H.P., and twin tandem up to 6,000 B.H.P. The design is simple and solid, so as to ensure the maximum of reliability and long periods of running without adjustment being necessary. In several of the installations which have been carried out by the company, the engines have to run night and day for long periods without a stop, in works where a breakdown would be a very serious matter.

The makers are strong advocates of the use of gas engines in conjunction with Mond gas producers and ammonia-recovery plant, the arguments in favour of which are well known to our readers; they have recently obtained an order for such an installation, in direct competition with the steam turbine, and under circumstances where great reliability was a prime essential. The load factor in this case was large, and the gas-engine plant was able to show very low running costs, which turned the scale in its favour.

The sectional drawing of the engine, which we reproduce in fig. 28, shows that the cylinders are built in one piece, the makers finding this the most satisfactory plan; all parts are cooled by water under a head of 30 or 40 ft., except the pistons, which require a pressure of 50 lb. per sq. in. The water-cooling pipes are all brought out to one side of the engine, and discharge into large funnels, so that the driver can always feel the temperature of the water; thermometers are also provided on all the pipes. Governing is effected on the quantity system, the lift of the inlet valve being lessened on light load, and thus reducing the amount of mixture entering the cylinder.

The company has received the order for four gas engines of 2,300 B.H.P. each, from the Imperial Japanese Government, to generate electricity for the operation of an electric railway between Tokio and Yokohama.

Running Costs of the Diesel-Engined Ship.

With the actual adoption of the large Diesel engines in cargo vessels, the purely commercial side of the question of their use is naturally being much discussed.

In its last issue the *Motor-Boat and Marine Oil and Gas Engine* publishes an interesting comparison of operating costs derived from an authoritative source. The case for the steamship is stated by well-known steamship owners, and a steamer of 10,650 tons displacement and 7,400 tons D.W. capacity driven at 11 knots is compared with the *Selandia*, 9,800 tons displacement, 7,400 tons D.W. capacity, speed also 11 knots. Taking 75 days steaming, coal would cost £3,150, as against oil £1,575. The steamer would also lose two days per voyage in coaling, reckoned by the owners at £92. Taking the first cost of the steamer at £60,000 and of the motor ship at £75,000, the latter depreciates £250 per voyage more; there is also an estimated saving in D.W. cargo capacity of 210 tons, or £210 per voyage in favour of the steamer, so that the net gain of the motor-ship is £1,207 per voyage, or £3,621 per annum, the case of three Far-Eastern voyages per year being assumed. It may be noted that the same total wages are reckoned for each ship.

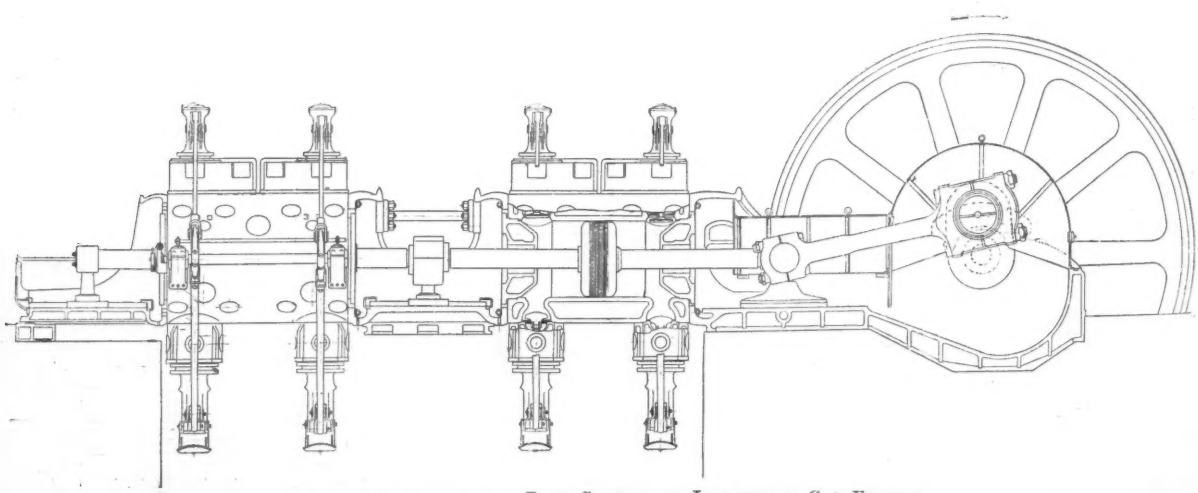

FIG. 28.—ELEVATION AND PART SECTION OF LILLESHALL GAS ENGINE.

The Brit Oil Engine.

MESSRS. E. A. CHARD & CO., of Bridport, make the Brit engines, which are fitted to use either paraffin or petrol fuel, or town gas. It is claimed that they are easy to start and understand, very economical, and perfectly reliable. A centrifugal governor controls the speed, which can be varied, and regulates the fuel consumption according to the load. The ignition is by low-tension magneto, and lubrication is by direct feed and splash.

Thornycroft Motors.

Messrs. John I. Thornycroft & Co., Ltd., of Caxton House, Westminster, S.W., have for many years built high-speed oil engines, which are specially designed to secure reliability of lubrication, steadiness of running, and cheapness of operation. These ends are attained by the adoption of an improved system of forced lubrication, an efficient vaporiser and governor, and the use of the cheapest grades of oil. One of their standard paraffin M1 type dynamo sets, capable of developing 3½ kw., is shown in fig. 30.

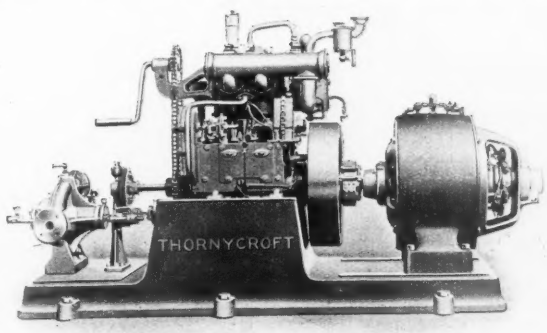

Fig. 29.—Thornycroft 7-kw. Set with Pump.

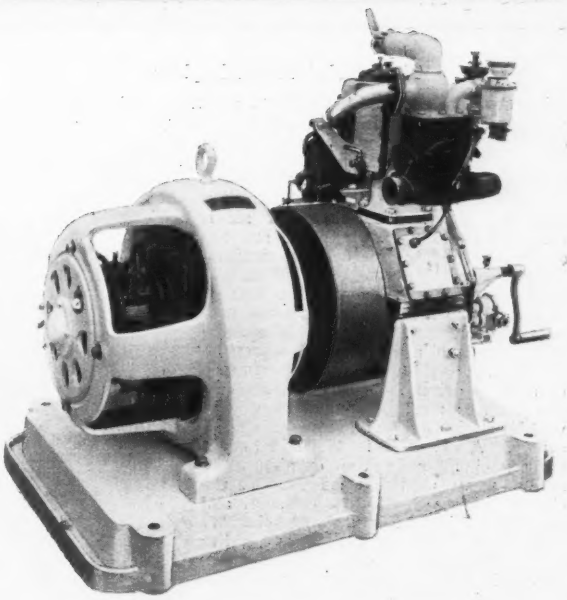

Fig. 30.—Thornycroft 3·5-kw. Oil-Electric Set.

The vaporiser is very clearly seen, and is generally representative of the type fitted to all their paraffin oil engines. These sets are all capable of governing within 5 per cent. The dynamo is of the E.C.C. make, and runs at 25 volts.

Another set is shown in fig. 29, and represents a type of plant which has become very popular in the Far East for house lighting and pumping. The engine is of type M2, and is coupled to a dynamo of 7 kw. output, at 110 volts. The pump is driven by gearing from the other end of the shaft, and is capable of lifting 2,000 gallons per hour to a height of 70 ft., so that it is useful not only for domestic purposes, but also for extinguishing fire, &c.

Three of their oil-engine-dynamo sets are installed in the firm's power house at Basingstoke, of 39 kw. each, and are in constant use, especially for overtime work, needing very little attention. One has been running for six years, and the other two for three. The standard sizes made range from 3·5 to 45·5 kw.

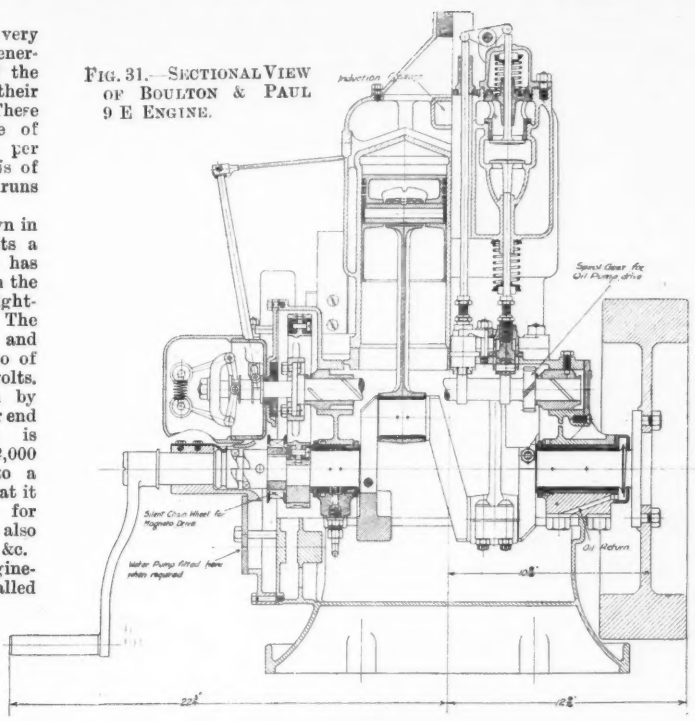

Fig. 31.—Sectional View of Boulton & Paul 9 E Engine.

Boulton & Paul, Ltd.

This well-known Norwich firm took up the construction of the small petrol engine for both land and marine purposes a few years ago. They manufacture both four and two-cycle engines, the latter in the small sizes being less costly, and perhaps rather simpler in construction. A typical section of the former is given in fig. 31.

The firm's standard engines range from 1½ to 42 b.h.p. in size, the speeds being generally 900-1,000 r.p.m., and the fuel petrol, although they can be adapted for paraffin, giving a somewhat smaller output.

An interesting little set, which we select for illustration, comprises a four-cycle petrol engine coupled directly to a dynamo and pump in tandem, on one bed-plate (fig. 32). A clutch is inserted between dynamo and pump. The engine is provided with thermo-siphon water cooling, and forced lubrication to all bearings; the standard ignition is by means of h.t. magneto, but ordinary coil and battery ignition can be fitted.

The engine is governed on the throttle, and when arranged for the use of paraffin is started up on petrol. The consumption of petrol and paraffin on full load is approximately ·75 and ·8 pint respectively. Messrs. Boulton & Paul have specialised in house-lighting equipments, each complete with engine, dynamo, battery and switchboard, and these can be supplied for installations of 50 to 600 16-c.p. metal lamps.

Browett, Lindley and Co., Ltd.

Messrs. Browett, Lindley & Co. entered the gas-engine field some years ago, when they built some vertical enclosed engines with forced lubrication; the success of these led them to form a special department to deal with this class of work, and they have several orders in hand, including one for an engine of 360-400 b.h.p. for the Corporation of Wanganui, New Zealand, to drive the electric tramways in that town. Unfortunately the coal strike has delayed their work, so that we are unable to include a description of the engine in this issue.

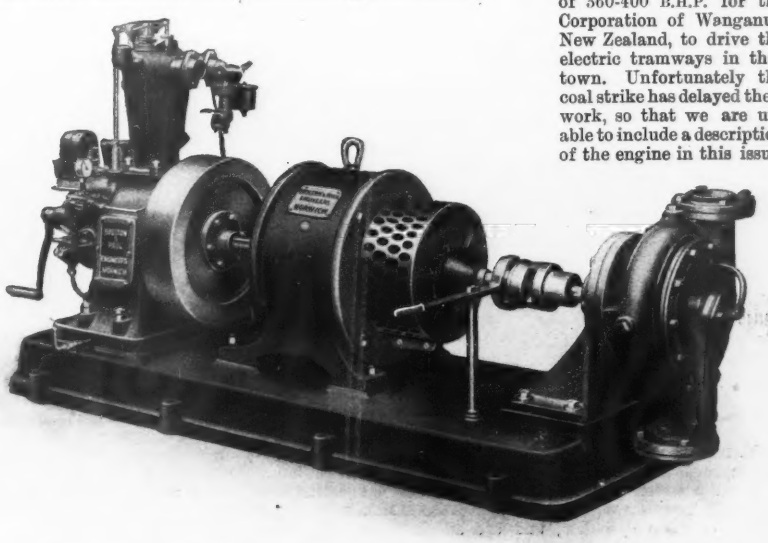

Fig. 32.—Boulton & Paul Engine Driving Dynamo and Pump.

The Blackstone Oil Engines.

MESSRS. BLACKSTONE & CO., LTD., of Stamford, have for many years been building oil engines, and some three years ago they embarked on the manufacture of crude-oil engines, which they have developed to a high degree of efficiency. The engine works on the four-stroke cycle and the Diesel principle, but uses a lower compression than the latter. The charge of air is compressed to 150 lb. per sq. in., and the oil is sprayed into the cylinder, ignition being effected by means of a bulb-shaped ignition chamber bolted to the back of the cylinder, which is kept at a red heat by the explosions. The oil is sprayed in by air from a reservoir at a pressure of 400 lb. per sq. in., which is kept charged by a pump driven from the crank-shaft by an eccentric; a small plunger pump with variable stroke feeds and regulates the oil supply. A little oil is blown into the ignition chamber by the opening of a needle valve, at the same time as the charge is sprayed into the cylinder, and the resulting jet of flame from the chamber meets the charge in the cylinder and ignites it, producing a flat-topped indicator diagram, in which the maximum pressure is only about double the compression pressure. The amount of oil admitted tothe ignition chamber is simply that required to run the engine light, and remains constant at all loads, while the charge admitted directly to the cylinder is controlled by the governor, in proportion to the load. There are no missed ignitions, so that the ignition chamber is always maintained at the proper temperature.

A centrifugal governor with both gravity and spring control is used, the spring enabling the speed to be adjusted while the engine is running. The ignition chamber is heated by a blow-lamp to start the engine.

The firm makes both vertical and horizontal crude-oil engines on these lines; one of the former, a four-cylinder set of 80 B.H.P., is shown in fig. 33. It is of the enclosed type, with forced lubrication, and has a vertical air-compressor worked off an extension of the crank-shaft. Each cylinder has a special valve connected to the air reservoir, for starting, and a burner for heating the ignition-chamber, shown in front of the cylinder end. The oil pumps are actuated by bell-crank levers working in long slots in the ends of the pump plungers, seen at the end of the engine, and the stroke is regulated by the wedges there shown, which are lowered into the slots by the governor.

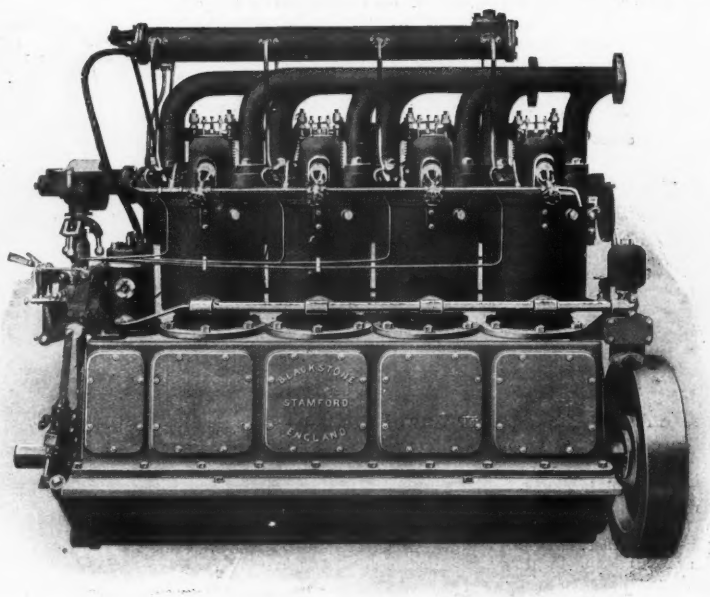

FIG. 33.—FOUR-CYLINDER BLACKSTONE CRUDE-OIL ENGINE OF 80 B.H.P.

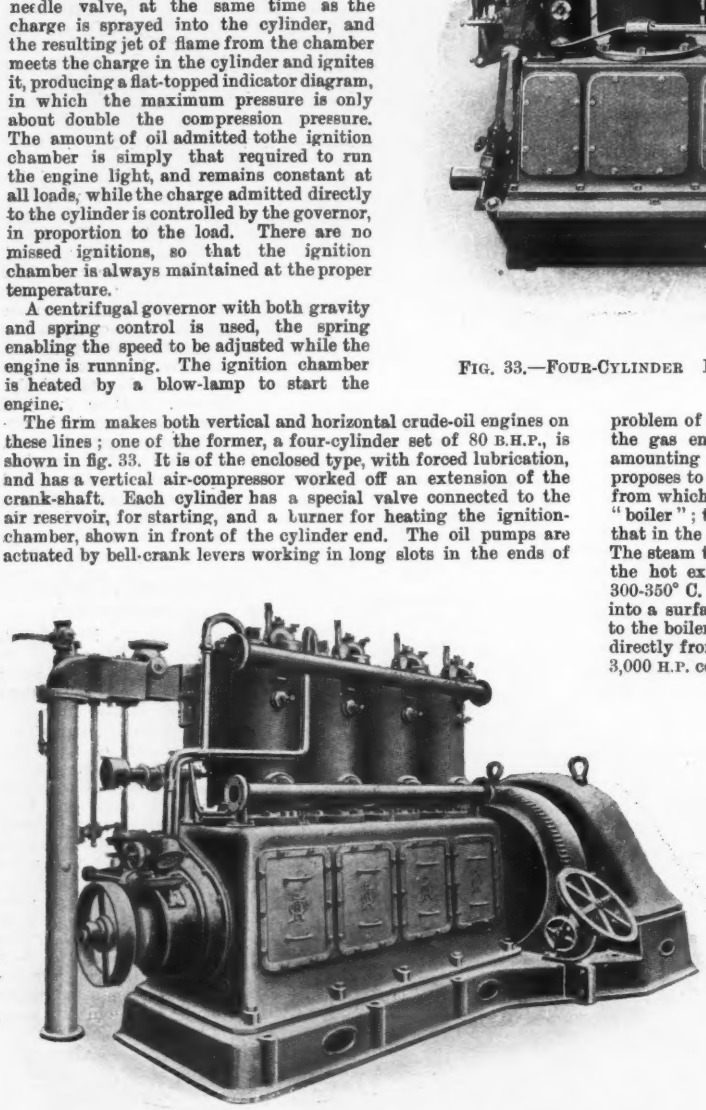

FIG. 34.— ANDERSTON HIGH-SPEED GAS ENGINE.

Anderston Vertical Gas Engines.

THE ANDERSTON FOUNDRY CO., of Glasgow, have for some years been associated with the construction of vertical gas engines.

The Anderston engines are of the vertical single-acting type, and are built in sizes ranging from 20 to 500 B.H.P., with either two, three, or four cylinders, and are adaptable for use with any ordinary or waste gas.

The engines run at comparatively high speeds—600 R.P.M. in the smaller sizes, up to 250 R.P.M. in the largest size mentioned—and have been largely adopted for electrical driving.

We illustrate one of the Anderston engines in fig. 34, which gives a general idea of the constructive features of these engines.

Utilisation of Waste Heat from Gas Engines.

A German engineer, Mr. C. Semmler, has applied himself to the problem of utilising part of the heat energy at present rejected by the gas engine in the cooling water and exhaust gases, each amounting to about one-third of the total heat consumed. He proposes to subject the cooling water to pressure in the jacket, from which it passes at a temperature of 110° to 150° Cent. into a "boiler"; the pressure in the boiler is kept at a lower value than that in the jacket, so that a portion of the water is evaporated. The steam thus formed is led through a superheater, surrounded by the hot exhaust gases, and is there raised to a temperature of 300-350° C. It is then supplied to a steam turbine, exhausting into a surface condenser, and the water of condensation is returned to the boiler through the jacket, together with a quantity derived directly from the boiler. The inventor estimates that an additional 3,000 H.P. could be thus obtained from a plant of 20,000 H.P.

Bituminous Gas Producers.

According to an article by Mr. R. L. Streeter in the *Engineering Magazine*, there were in the United States, at the end of 1909, 474 producer-gas plants, of which 415 used anthracite, 37 bituminous coal, and 22 lignite. Of the bituminous-coal plants, 20 were larger than 500 H.P., the average being 1,460 H.P., and three of the lignite plants were over 500 H.P. Since then the number and size of installations have very rapidly increased.

In some of the bituminous producers the down-draught system is employed, the air and steam supply being admitted at the top of the producer and passing downwards through the hot bed of fuel, to eliminate the tar from the resulting gas. When the up-draught system is used, the tar is kept down to the minimum by adjustment of the air and steam, and is removed by means of a mechanical scrubber.

A 600-H.P. plant fed with Texas lignite, in a district where water is scarce, is provided with cooling towers for the water used for cleaning the gas; the same water is continuously circulated without purification, it being found that the amount of solids present in the water increases up to a definite limit, when the excess impurities are precipitated without any chemical treatment. Moreover, it is not necessary to add any make-up water, as the moisture contained in the lignite, amounting to 30 per cent., is condensed in the scrubbing apparatus, and thus more than compensates for loss by leakage and evaporation, the surplus having to be run off.

At the works of the Pittsburg Plate Glass Co., Indiana, four 750-KW. alternators are driven by gas engines fed with producer gas from bituminous coal, and the plant, which was installed in 1908-9, is soon to be enlarged to 10,000 H.P. The producers are of the down-draught type.

It would appear, therefore, that the difficulties which have hitherto militated against the use of bituminous coal and lignite in gas producers are being successfully overcome in the States.

J. F. Coates & Co.

This Manchester firm has specialised in the two-stroke engine, which is of extremely simple construction, as may be gathered from the fact that the working parts comprise only piston, connecting rod and crank.

For running on petrol, the Ruth series of engines giving from 2 to 24 H.P. (at from 850 to 680 R.P.M.) are made. These engines, except in the smallest size, are fitted with a special exhaust scavenging arrangement, an intermediate chamber being provided between

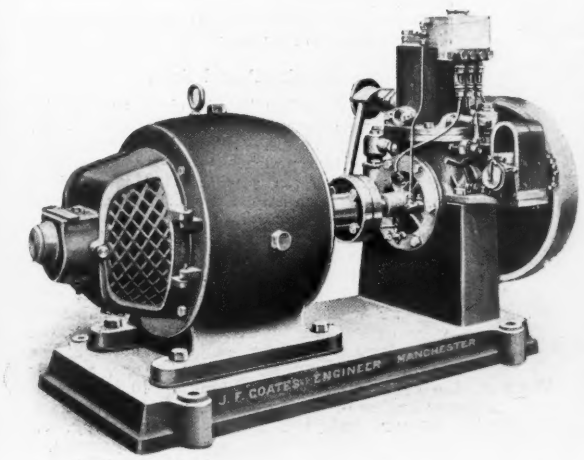

Fig. 35.—Coates Two-stroke Paraffin-Electric Set.

crank case and cylinder, into which pure air is drawn by the piston on its upstroke. On uncovering the inlet port, this air is swept through the cylinder, clearing out the burnt gases, before the admission of the new charge.

H.T. magneto ignition is fitted, and a sensitive governor; the sets are largely used for driving small dynamos.

Messrs. Coates build a somewhat similar engine—the Ajax—which we illustrate in fig. 35, for running on paraffin and starting on petrol. The ordinary two-stroke arrangement is followed, the vapour mixture being held in a special transfer pipe until the cylinder port is uncovered and the air pressure in the crank case forces it into the cylinder.

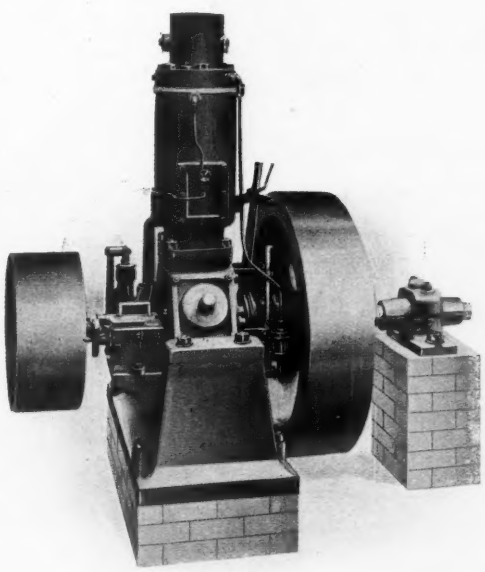

Fig. 36.—Two-stroke Semi-Diesel Engine by J. F. Coates & Co.

No explosive mixture is drawn into the crank case, only cold air through a special valve, and this is a point of divergence from ordinary practice.

It is claimed that the engines govern within 3 per cent.; they are fitted with H.T. magneto ignition and designed for easy dismantling and access.

The Coates semi-Diesel oil engines—of the vertical two-cycle type—are made in sizes from 8 H.P. to 60 H.P., with one or two cylinders, and will operate on crude oil or paraffin.

We illustrate one of these engines in fig. 36. The small sizes start up with the usual hot bulb and blow-lamp arrangement; in the larger sizes compressed air is used. A certain amount of water from the cylinder head is fed through the inlet ports with the incoming air at each stroke, and vaporised by the hot bulb, keeping the latter at a suitable temperature (dull red heat), and the makers claim increased power by this arrangement. Oil fuel is fed to the cylinder (being injected through a needle valve) by a plunger pump, the stroke of which is adjusted by a fly-wheel governor operating a variable cam.

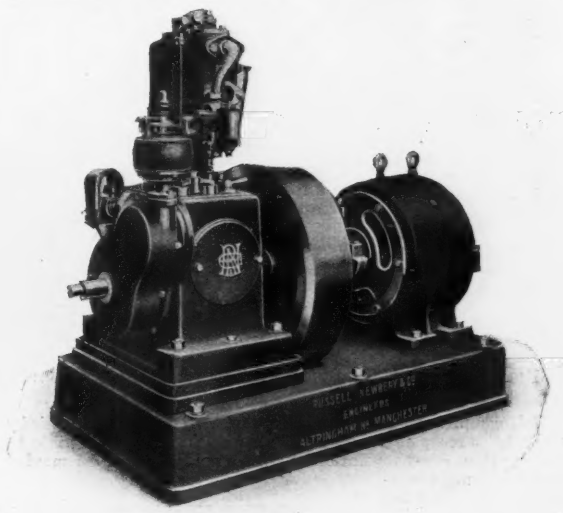

Fig. 37.—Russell, Newbery 5-K.W. Electric Lighting Set.

The lubrication and water-cooling arrangements have been carefully arranged, and constructional facilities are provided for dismantling and inspection.

This being a two-stroke engine, the crank-chamber compressed air is employed for scavenging, and the crank-case compression is maintained by revolving bronze shaft washers pressed against the bearing ends by springs.

The Coates engines, it may be added, are designed and used equally for marine or stationary purposes.

Russell, Newbery & Co.

Messrs. Russell, Newbery & Co., of Altrincham, manufacture a variety of small and medium-size internal-combustion engines suitable for dynamo driving, some examples of which are illustrated herewith.

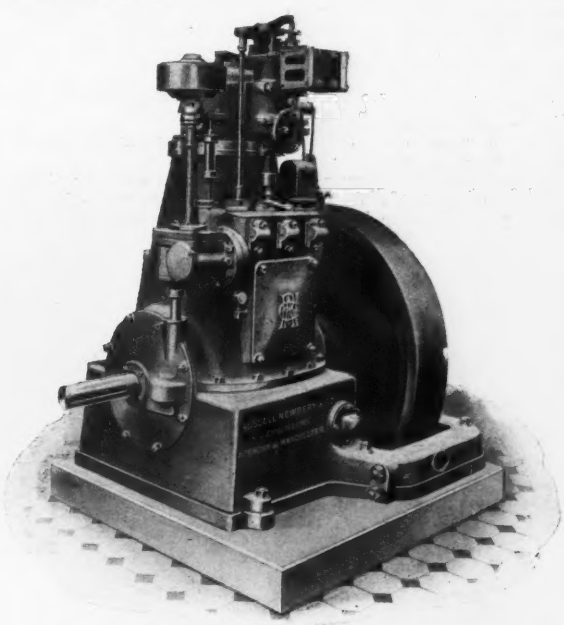

Fig. 38.—Vertical Suction Gas Engine, 25 B.H.P.

Fig. 37 illustrates their 5-KW. direct-coupled single-cylinder petrol-electric plant, running at 650 R.P.M. This engine has been specially designed to withstand rough usage and to be suitable for long and continuous runs with a minimum of attention. The camshaft is driven by means of machine-cut spur gears from the crankshaft; the method of driving the vertical governor and

magneto calls for special mention, both being driven by means of phosphor-bronze spiral gears meshing in a common mild steel driver at the end of the camshaft.

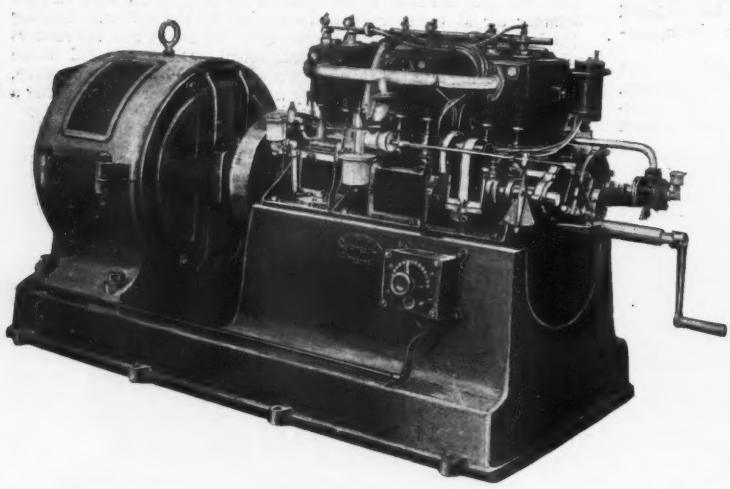

FIG. 39.—BROOKE SIX-CYLINDER ELECTRIC LIGHTING SET FOR PERNAMBUCO.

Half-compression gear is provided for starting; lubrication is by "splash," a scoop at the end of the connecting rod dipping into an oil trough at every revolution, and flinging oil to all the moving parts. The main bearings are provided with automatic ring lubrication, and the ignition is by H.T. magneto. The firm are also manufacturing vertical gas engines. The illustration (fig. 38) represents their 25-B.H.P. single-cylinder vertical suction gas engine, with a speed of 350 R.P.M.

Special attention may be drawn to the method of supporting the cylinder liner, by means of which exceptional rigidity is obtained; it is cast integral with the combustion head and is securely bolted to the upper casing of the crank chamber, the lower end being supported by means of an internal ring in the upper casing, which is bored to receive it—thus the liner is perfectly free to expand, and no distortion can take place.

Forced lubrication is fitted to the main bearings, crank-pin, and piston pin, the pump being situated at the lowest point of the crank case and driven by means of an eccentric and rod from the cam shaft; the pressure of oil in the system is always under observation on the gauge.

The cam-shaft is driven by means of spiral gears from the crank-shaft, and can be withdrawn bodily with all the cams at a moment's notice by simply slacking back one set-screw.

The engine illustrated is governed by means of the "hit and miss" method on the gas valve for factory driving, but if required for electric power, the throttling method on both gas and air is employed. Ignition is by means of L.T. magneto and trip gear. The time of firing can be altered at will when the engine is running; this prevents any possibility of backfires at starting, and ensures the engine running with the highest efficiency.

The engines illustrated are manufactured in eight sizes, one to four cylinders, of 15-120 B.H.P.

Brooke Petrol Sets.

We illustrate in figs. 39, 40 and 41, some of the petrol-electric manufactures of MESSRS. J. W. BROOKE & CO., Lowestoft. Possibly the most interesting is fig. 40, representing half-a-dozen sets of petrol-engine driven searchlight plants which have recently been shipped for the Greek Government. These sets are in conjunction with complete equipments for six Customs service boats for work amongst the islands, comprising a 25-H.P. Brooke engine, propellers, &c.

The searchlights are of 18-in. diameter, and, together with the dynamos and switchboards, were constructed by Messrs. Crompton & Co. They have a working radius of 600 m. The engine is a 4-H.P. single-cylinder one, running at 950 R.P.M., the dynamo having an output of 40 amperes at 70 volts. A larger engine of similar build, having six cylinders and developing 25 H.P. and 16·5 KW. is shown in fig. 39, which represents a plant recently forwarded to Pernambuco.

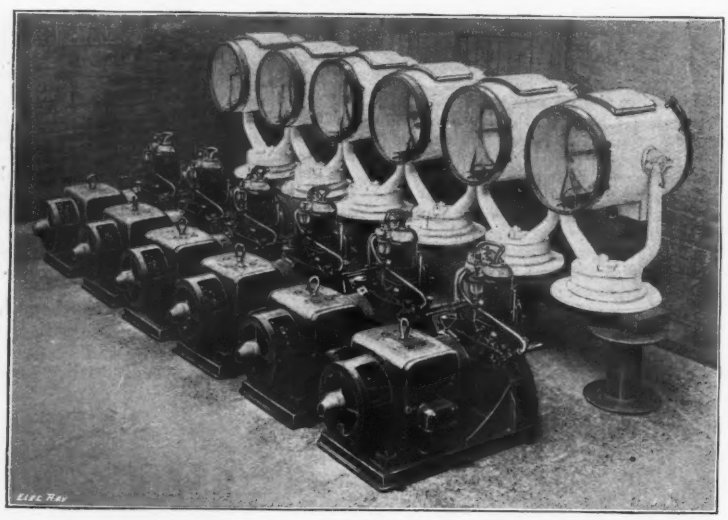

FIG. 40.—BROOKE PETROL-ELECTRIC SETS AND SEARCHLIGHTS.

The Aster Engine.

One of the best known of the small internal-combustion engines operating on petrol or paraffin, is the Aster, made by the ASTER ENGINEERING CO., LTD., Wembley, of which there are over 18,000 at present in use on motor-cars, aeroplanes, boats, and for electric lighting, pumping, cinematograph and wireless purposes. This engine is constructed for powers up to 70 B.H.P., and we illustrate in fig. 43, p. 639, a 35-H.P. engine of this type coupled to a dynamo, with a speed of 950-1,000 R.P.M.

The engine is provided with a well thought-out lubricating system, the oil being drawn from the crank-case sump by means of a geared pump and forced through ducts to the crank-shaft journals, through a slot in the latter and an axial hole into the crank-shaft, which is pierced with oil-ways leading to the connecting rod big-ends, and eventually to the cylinders, from which it is returned through a filter to the

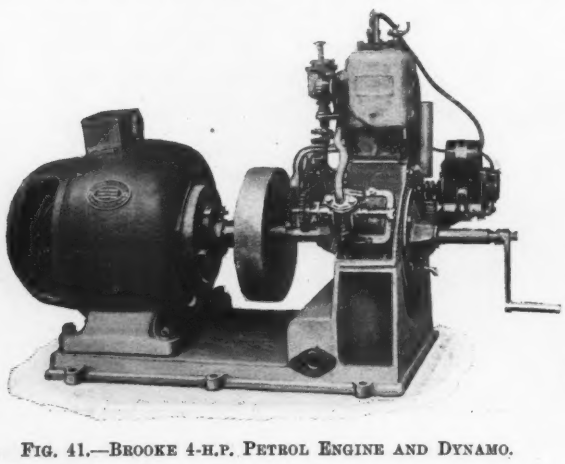

FIG. 41.—BROOKE 4-H.P. PETROL ENGINE AND DYNAMO.

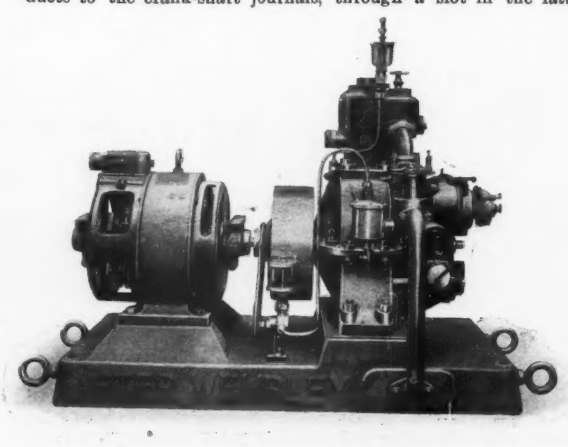

FIG. 42.—ASTER 1·4-KW. PETROL-ELECTRIC SET.

sump. A sensitive fly-ball type of governor running in oil is fitted, and Bosch H.T. magneto ignition; the engine is governed on the inlet and fitted with mechanically operated valves.

A feature of these small generating sets is the Aster flexible coupling, which greatly simplifies the erection of engine and dynamo,

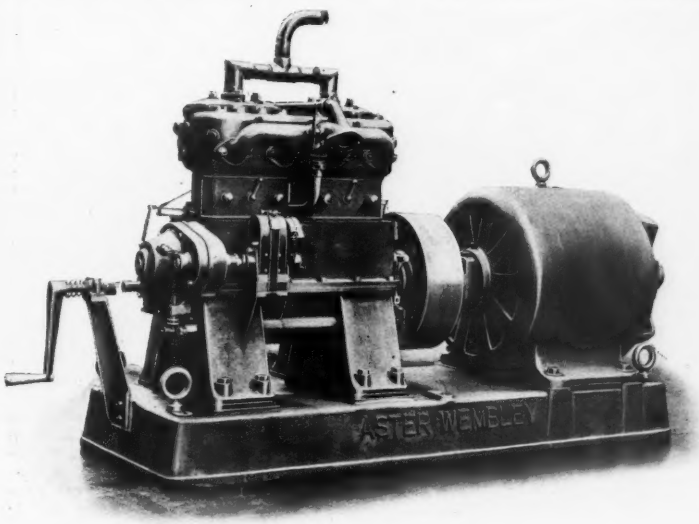

Fig. 43.—Aster 35-h.p. Engine and Dynamo.

and provides sufficient elasticity to absorb shocks. These sets are designed for petrol or paraffin fuel, but are adaptable for use with gas.

Fig. 42 shows a single-cylinder generating set, with an output of 1·4 kw. at 1,200 r.p.m. A large number of these sets have been supplied for country house lighting purposes, for which they are well adapted owing to the smooth running obtained with the inside fly-wheels.

The magneto, and when necessary the water-pump, is driven off the main shaft by means of a skew-gear at right angles, all these gears being enclosed in oil-tight cases. The governor is driven off an extension of the cam shaft and actuates the throttle; it also is enclosed in an oil-tight case. The engine exhaust is utilised to heat up the air supply to the carburettor, which is supported on the air pipe as shown in our view.

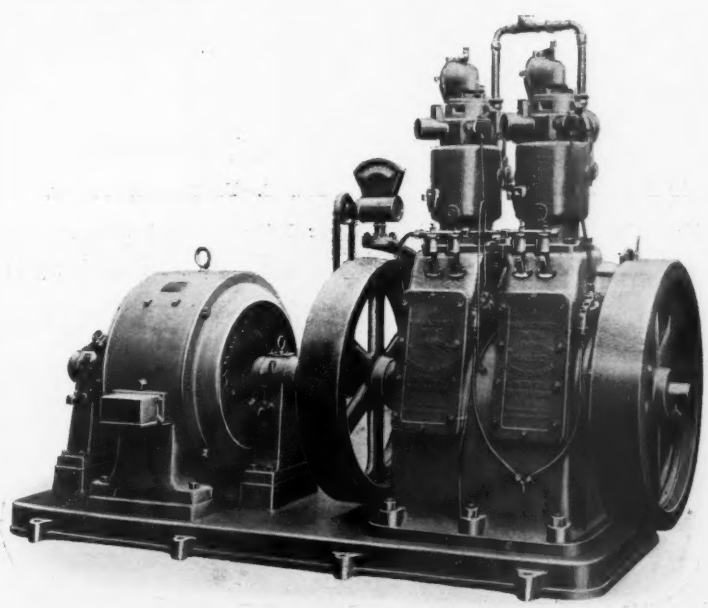

Fig. 44.—Cross 20-h.p. Oil-Electric Set.

Aster portable sets mounted on a trolley with a canopy have proved very popular for cinematograph work, over 300 of them having been supplied for this purpose alone; the makers claim a generating cost of about 1½d. per unit.

The Cross Oil Engine.

A handy type of oil engine—known as the Cross oil engine—for operating on petroleum, kerosene, or even crude oils, is made by the Westinghouse Brake Co., Ltd., London.

This engine is of the vertical single-acting four-cycle type, designed for high speeds and making use of the heat of compression to ignite the fuel charge sprayed into the combustion chamber of the cylinder during ordinary running.

The upper end of the cylinder forms the combustion chamber, into which a small iron bulb, previously heated by a blow lamp, is screwed for the purpose of igniting the charge when first starting up.

The engine speed is controlled by a governor which varies the stroke of a small oil fuel pump, regulating the amount of oil sprayed into the cylinder at each power stroke.

The fuel injection is gradual, in order to obtain gradual combustion rather than explosion of the charge, this arrangement ensuring more even running and less severe stresses on the working parts. The engine valves are all mechanically driven from a cam-shaft running at half engine speed, and the bearings are of hard bronze.

The lubrication of the engine is positive and automatic—an oil pump being provided, which draws oil from an oil well in the crank chamber, and circulates it to the main bearings and to troughs for splash lubricating the connecting-rod ends, &c.

We illustrate in fig. 45 a sectional view of a 10-h.p. Cross engine from which the general arrangement can be seen, while fig. 44 shows a 20-h.p. two-cylinder set direct-coupled to a dynamo for country house lighting and similar purposes.

The Hindley Gas Engine.

As makers of a very successful short-stroke high-speed vertical gas engine, Messrs. E. S. Hindley & Sons, of Bourton, have achieved some fame. Their engines are all built on standard lines and embody various constructional improvements more or less peculiar to the Bourton engines. The cylinders are each cast separate, but in one with the water jacket, which is

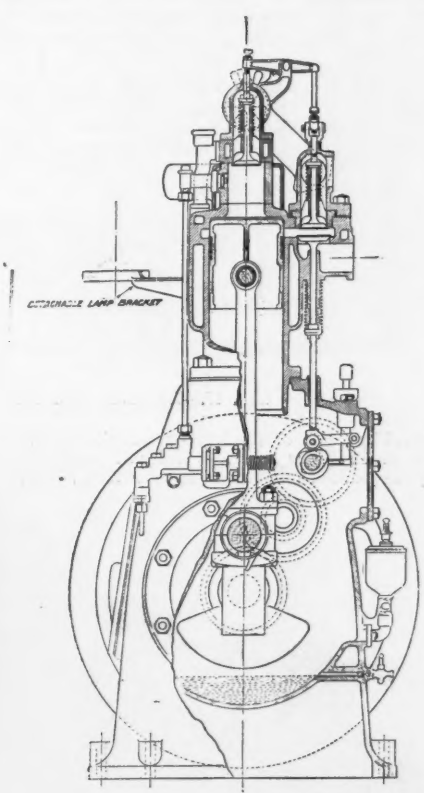

Fig. 45.—Section of 10-h.p. Cross Oil Engine.

corrugated and allows for unequal contraction of parts after casting.

The engines are provided with forced lubrication, throttle-governing—with a crankshaft governor and balanced mixture valve—L.T. magneto ignition, &c., with a trip-gear designed so as to avoid the possibility of accident should the engine be turned in the wrong direction. Messrs. Hindley have supplied many of their plants to foreign and Colonial users, and build suitable producer plants for use with all classes of fuel, including semi-bituminous coal, wood chippings, peat, &c.

Maschinenfabrik Thyssen & Co., A.-G., Mulheim-Ruhr.

In figs. 46-48 we illustrate some large gas engines recently constructed by MESSRS. THYSSEN & CO., of Mülheim-Ruhr, for driving electric generators. The engines shown in fig. 46 are twin-engines, but in details of construction these are identical with that illustrated in figs. 47 and 48, which is a single-crank engine erected at the Pluto Mine of the Gelsenkirchen Co., at Wanne, and runs on coke-oven gas. It has, it will be seen, two double-acting cylinders, arranged tandem fashion, the diameter being 1,150 mm. (45·3 in.), and the stroke 1,300 mm. (51·2 in.). The jacket, it will be seen, is cast in one with the cylinder, but it is fitted with a renewable liner of hard cast-iron, which takes all the wear. Both cylinder heads and pistons are water cooled, as is best shown in fig. 47, and the water-cooling of the exhaust valves and the casings has been amply provided for.

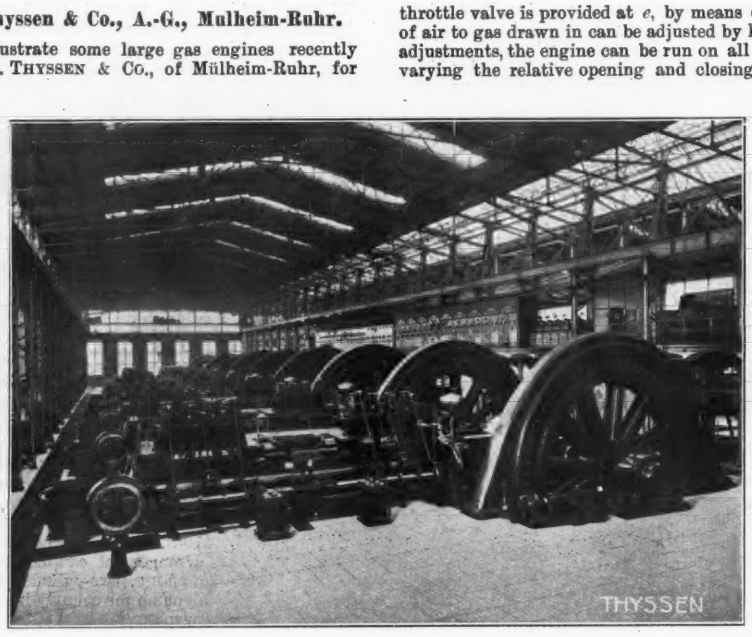

FIG. 46.—POWER STATION EQUIPPED WITH THYSSEN GAS ENGINES.

The gas supply to each end of each cylinder can be independently adjusted by means of the hand-wheels shown on the side of the right-hand cylinder in fig. 47, which actuate link-work by which may be opened or closed the valves, shown at *a* in both figures. This gas supply reaches the engine through the pipe shown at *b*, fig. 48, and, as indicated at *c*, a hand-hole is provided in the port leading to the gas valves, through which deposit can be removed if required. The air-supply pipe is represented at *d*, and, as will be seen, a throttle valve is provided at *e*, by means of which the proportion of air to gas drawn in can be adjusted by hand. Having these two adjustments, the engine can be run on all qualities of gas, since by varying the relative opening and closing of these valves on the air and gas supplies, the proportion of air to gas can be varied through a practically infinite range. The ports which lead from these adjustable gas valves to the cylinder are, as will be seen on reference to fig. 47, provided with additional throttle valves at *f* and *g*. These are under the control of the governor by means of the link work, shown on the right hand of the cylinder in fig. 48.

The inlet valve, it will be seen, is double, there being a gas valve on the same spindle as the main inlet valve; and there is also a sleeve on the same spindle, which, when the valve is seated, covers the air port. Thus the opening to air is always proportional to the opening for gas. These inlet valves are operated by an eccentric on the side shaft, and have a constant opening, the governing being effected, not by varying the lift or the duration of opening of this valve, but by opening or closing the throttle valves at *f* and *g*. The exhaust valves are located below the cylinder, and are wholly contained in independent castings, which can readily be removed should the valves require examination or repair. As will be seen from fig. 47, a crosshead is fitted between the two pistons, and the left-hand cylinder has a tail-rod, also supported by a guide Hence the weight of the pistons and rods is entirely taken

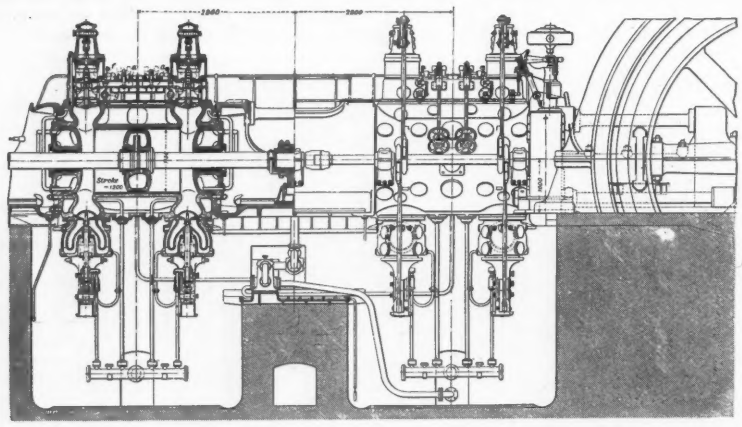

FIG. 47.—LONGITUDINAL SECTION OF THYSSEN ENGINE.

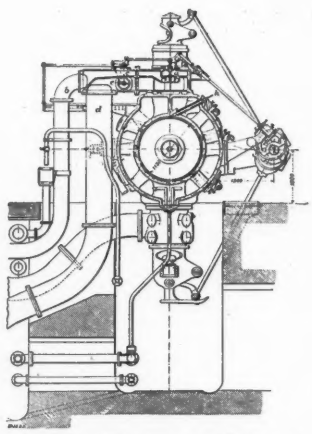

FIG. 48.—TRANSVERSE SECTION.

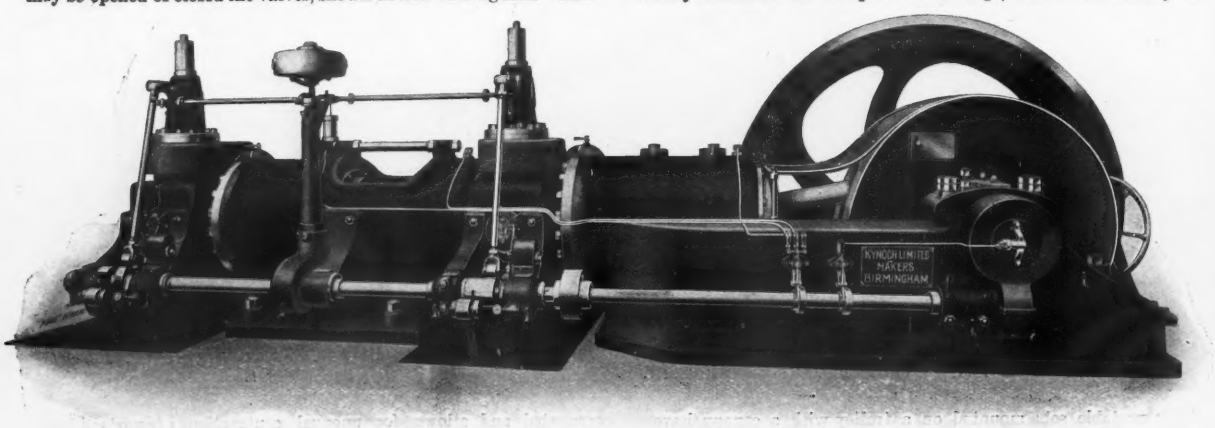

FIG. 49.—KYNOCH STANDARD TANDEM ENGINE FOR ELECTRIC LIGHTING.

off the glands, which have thus no tendency to wear oval. The gland packings are of the metallic type.

As is shown in fig. 47, the two cylinders in tandem are connected at the top by steel stays supplementing the "tween" casting below. Similar stays lead from the first cylinder to the top of the main bearings, and the engine-framing is thus relieved from the bending strains which in the past have frequently proved disastrous.

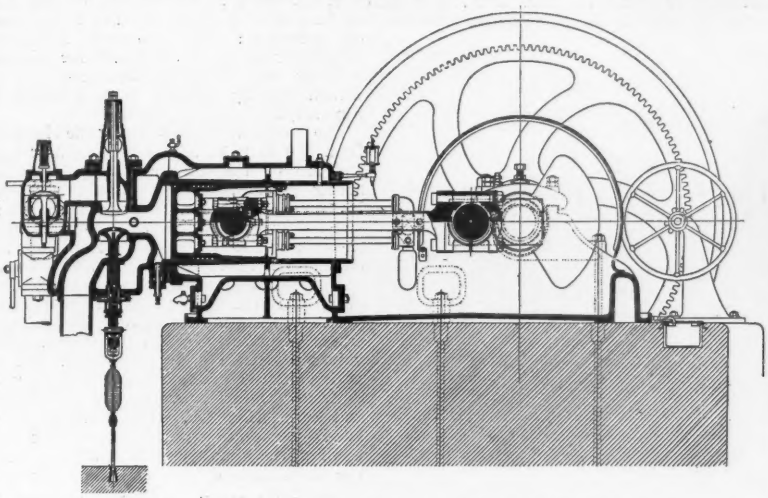

Fig. 50.—Longitudinal Section of Kynoch Engine.

These stays, being of steel, occupy little room, and scarcely affect the accessibility of the glands and cross-head. Forced lubrication is fitted to the cylinders, oil being pumped in through a pipe passing through the water-jacket, as indicated at *h*, fig. 48. The engine operating on the four-cycle principle, the side-shaft has, of course, to be geared down. This is effected by spiral gearing located between the fly-wheel and one of the main bearings. This gearing is completely enclosed, and runs in an oil bath.

The crank-shaft has three bearings, that on the right hand having a spherical seat. The brasses are lined with white metal, and the lubrication is forced, so that long continuous runs present no difficulty.

Messrs. Thyssen, we may add, have supplied the equipment for the largest gas-power station on the Continent of Europe, viz., that of the Gewerkschaft Deutscher Kaiser, in Bruckhausen. Here there are in all eight large blowing-engines and 12 large gas-engine generator sets, having an aggregate rated capacity of 60,000 B.H.P. The engines run on blast-furnace gas. The equipment for cleaning this gas is very complete, and as it enters the engines the gas does not contain more than 0·03 gramme of dust per cubic metre. As a consequence, it has been found possible to run the engines without cleaning them for from one-and-a-half to two years. The station load, as a whole, is very steady, and the power factor is consequently high, reaching the very satisfactory value of 70 per cent.

Kynoch Gas Engines.

Messrs. Kynoch, Ltd., of Birmingham, have developed a standard line of horizontal gas engine and producer plants specially adapted for electric lighting and similar purposes. The engines are built to gauge, and interchangeability of similar parts is assured; in size they range from 26 B.H.P. to 165 B.H.P. in the single-cylinder pattern, and from 220 to 660 B.H.P. in a tandem pattern, with speeds of from 250 to 160 R.P.M.

The principal constructional features of the Kynoch engine can be gathered from fig. 50, which shows the cylinder and valves in section. The cylinder-liner joint has no contact with either water or explosion, thus avoiding a frequent cause of leakage; hand-holes are provided for cleaning both cylinder and combustion chamber, and special water cooling for the piston is a feature of engines of 125 B.H.P. and over, this also applying to the exhaust valves in large engines. The three main valves are of the mushroom type, arranged vertically, and driven from the cam-shaft by a straight-line motion.

Other features are balanced cranks, marine type connecting rod, bearings removable without lifting crank, up-to-date lubrication, and magneto ignition with a special slow-speed engagement of trip gear, so arranged that the point of ignition can be varied within very wide limits while the engine is running. We illustrate in fig. 49 one of the firm's standard tandem engines for electric lighting which embodies the above features, and has an impulse every revolution.

The Kynoch suction-gas plant for use with the firm's engines has also been carefully considered. The gas generator consists of a brick-lined steel plate shell built on a cast-iron base, with a special water bottom forming a reserve water supply for starting up. An external vaporiser is provided, through which the hot gases from the generator are passed, cooling them on the way to the scrubber. The hopper has a slide feed, and the fire can be poked while the plant is working. The fan for starting is fitted with an air shutter, which is closed when the engine is running, also an oil bath for the gearing.

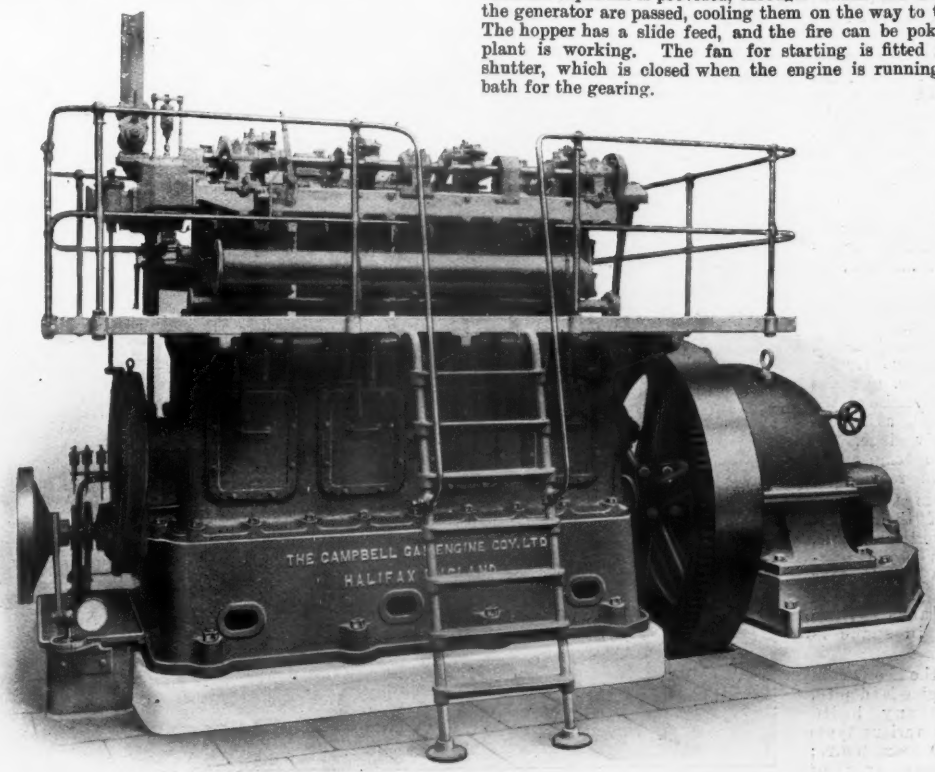

Fig. 51.—Campbell Four-Cylinder Vertical Gas Engine of 150 B.H.P.

Campbell Gas Engines.

The Campbell Gas Engine Co., Ltd., of Halifax, make both horizontal and vertical engines; the latter run to 575 B.H.P. with four cylinders on producer gas. Having been amongst the first to build vertical gas engines, the firm have acquired a lengthy and valuable experience in this line, and make a special feature of reliability. Many of their vertical engines have been installed in

electric power stations, where their economical working has been fully demonstrated.

The engines work on the four-stroke cycle, and the cylinders are entirely independent of one another, so that in case of need the engine can be run with one or more cylinders idle; the cylinder covers are not encumbered with valve gear, and can, therefore, be removed and replaced with facility. The valves are operated by a camshaft inside the crank case. All the main bearings are provided with forced lubrication, and the cooling water circulation is ensured by a centrifugal pump. The accompanying illustration (fig. 51, p. 641) shows a Campbell four-cylinder vertical engine of 400 B.H.P., directly coupled to a three-phase alternator. Among recent improvements effected in the design of the engine may be cited the following:—

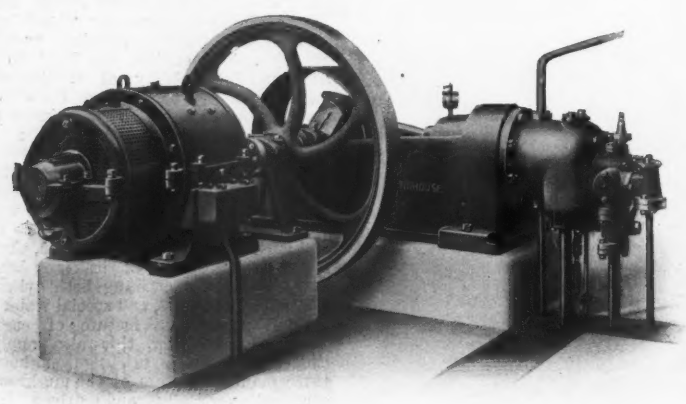

FIG. 52.—WESTINGHOUSE ELECTRIC LIGHTING SET, HORIZONTAL TYPE.

The Campbell Co. now provide an entirely independent lubrication system to the cylinders, and each cylinder is lubricated independently by means of a small force pump, which delivers the oil at several points round the piston.

The company now throw the centre of the cylinders off the crank centres, thus reducing the angularity of the connecting rod during the impulse stroke. By this arrangement the thrust of the rod is reduced by about 20 per cent., with a corresponding reduction in wear and tear.

The exhaust branch pipe taking the exhaust from the four cylinders is now water-jacketed, thus avoiding trouble from corrosion, and also reducing the noise of the exhaust, and, as a subsidiary advantage, reducing the temperature of the engine-room.

These are the chief features of their latest design of vertical engine, which is more particularly suitable for small station work, and other places where economy in space is essential.

Where the horizontal type of engine is adopted, the company build engines of various types up to 850 max. B.H.P.; the ordinary type of single-cylinder engine has not been modified to any material extent of recent years, at least up to 150 B.H.P., but engines above this power are now supplied with an outer slipper guide. This arrangement is somewhat more expensive than the older design of engine, but is well worth the extra expense.

The makers have recently shipped an engine of 420 maximum B.H.P. of the side-by-side type, designed on these lines, to a large mining concern in Western Australia. This engine is provided with a fly-wheel grooved for a rope drive, the crankshaft being of the built-up type. The crankshaft and camshaft bearings are provided with ring lubrication, and there is an independent forced system of lubrication to the other working parts.

Westinghouse Gas Engines.

THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., of Manchester, were early in the field of vertical gas-engine construction, and have developed this type to a high degree of perfection; they also make horizontal engines from 2 to 33 B.H.P. for electric lighting and other applications, one of which, directly coupled to a dynamo, is illustrated herewith (fig. 52).

The vertical engines are made in sizes from 100 to 915 B.H.P. with producer gas, and are of the tandem four-cycle single-acting type, giving one impulse per revolution on each crank. The top and bottom pistons are joined by a cast-iron sleeve, through which passes a steel bolt, and a stuffing-box is, of course, provided between the cylinders in the shape of a long hollow head, the connecting piston rod being provided with Ramsbottom packing rings where it passes through the head. The valves are made easily removable, and by taking off the cylinder cover it is easy to withdraw the pistons, lower cylinder head and connecting rod. The speed is regulated by a centrifugal shaft governor controlling the quantity of mixture admitted, the proportions of gas and air being constant at all loads. The engine runs at 200-325 R.P.M., according to size, and as there are usually several cranks, each receiving one impulse per revolution, the cyclic regularity of running is very high.

All important working parts and bearings are lubricated by force pumps, and the cylinders and heads are water jacketed, but even in the 1,000-H.P. size, neither the pistons, rods, nor the exhaust valves are water cooled. Starting is effected by compressed air acting in the bottom cylinder of each line; no half-compression cams or other relief devices are employed. Ignition is done with a high-tension coil.

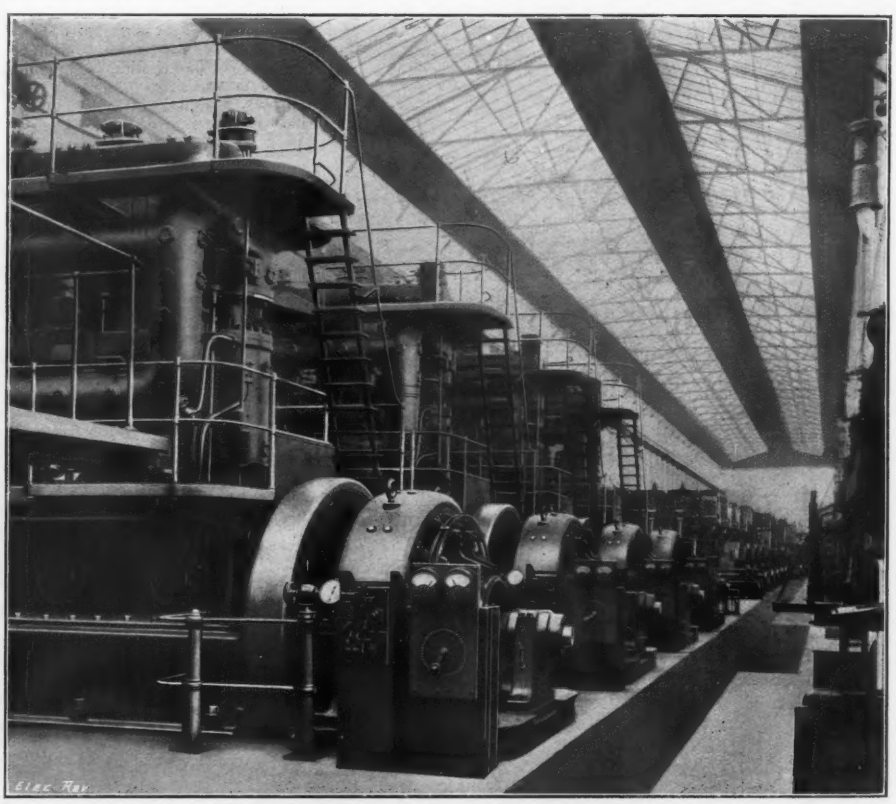

FIG. 53.—WESTINGHOUSE VERTICAL ENGINES AND DYNAMOS INSTALLED IN THE CASTNER-KELLNER CO.'S WORKS.

Many large electric power stations are equipped with these engines and Westinghouse generators; we illustrate one of these—at the works of the Castner-Kellner Alkali Co., Ltd., Runcorn—where four 500-KW. three-crank six-cylinder D.C. sets and two of 635 KW. are installed, working on producer gas. The plant is in continuous operation night and day, and the load factor attains to the remarkable value of 98 per cent.

We understand that Westinghouse vertical gas engines aggregating

about 300,000 B.H.P. have been installed, of which 60,000 H.P. is operating in this country. The company have also taken up the manufacture of the Diesel type of oil engine.

M.A.N. Engines.

The Maschinenfabrik Augsburg-Nurnberg A.G. need no introduction to our readers; as engine builders they have attained a world-wide repute, especially in connection with the larger type of gas engine operating on power gas, and the Diesel engine using crude-oil fuel.

The Nuremberg horizontal double-acting four-cycle gas engine has been frequently referred to in our pages, and has been continuously improved during the past 10 years. In the old design a tandem engine had 12 valves with separate eccentrics and rods, while the present engines (shown in fig. 54) have only eight valves

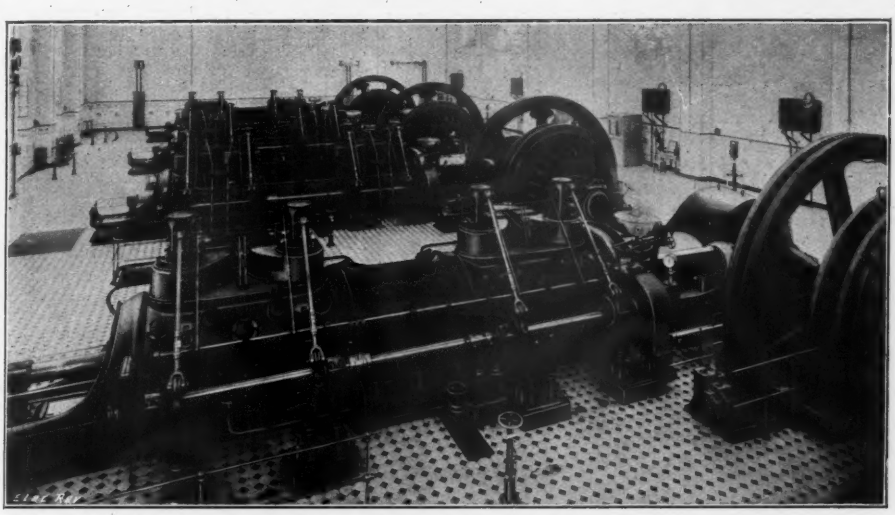

Fig. 54.—Modern Nuremberg Gas Engines, each of 1,150 B.H.P., in a German Works.

(four combined mixture and inlet valves and four exhaust valves) with four eccentrics and rods. Lengthy experience in design has also resulted in the production of perfectly reliable cylinder castings, despite the severe conditions under which these work.

The company is now regularly building cylinders for individual outputs of 1,200 to 1,500 B.H.P., giving outputs of 2,500 to 3,000 B.H.P. in a tandem engine.

When operating on blast-furnace and coke-oven gas (as in the case of the Bargoed installation in South Wales, described in these pages), the engines show astonishingly low working costs; the latter, exclusive of fuel costs, in the case of 10 electric power stations where 37 Nuremberg gas engines are employed, averaged ·0553d. per unit for wages, lubrication, cleaning material, repairs, and maintenance, &c.

Gas-engine power stations of this type, with capacities of 20,000 to 30,000 B.H.P., have now been successfully operated for some years, and a recent development, which deserves some attention, is the addition of Diesel engine plant in such stations to take the peak load, the gas engines meeting the normal steady demand.

Turning to the M.A.N. Diesel engine, we illustrate in fig. 55, one of the more interesting productions of the firm—a 1,600-2,000-B.H.P. horizontal Diesel engine driving a direct-current generator, and installed at the municipal electricity works at Halle. The engine is of the horizontal double-acting four-cycle type, and we understand that 15 similar engines of from 600 to 1,600 B.H.P. have been ordered from the company.

The peculiar merits of the horizontal type of Diesel engine, of which the M.A.N. Co. are the pioneers, are somewhat open to discussion at present; the firm has, of course, built many thousands of the vertical type of engine in all sizes, and can point to such examples as the 13 Diesel engines of 4,500 B.H.P. operating the Kieff Tramways, and seven similar engines for the Saratov Tramways power house. An interesting internal-combustion engine power plant which the firm is equipping will contain both blast-furnace gas engines and two M.A.N. Diesel engines each of 2,000 B.H.P. and running on coal-tar oil. These engines will be of the horizontal two-cycle single-acting type, and it is worthy of note that electric power stations with four to six engines, of this type, each of 2,000 B.H.P., are at present under consideration.

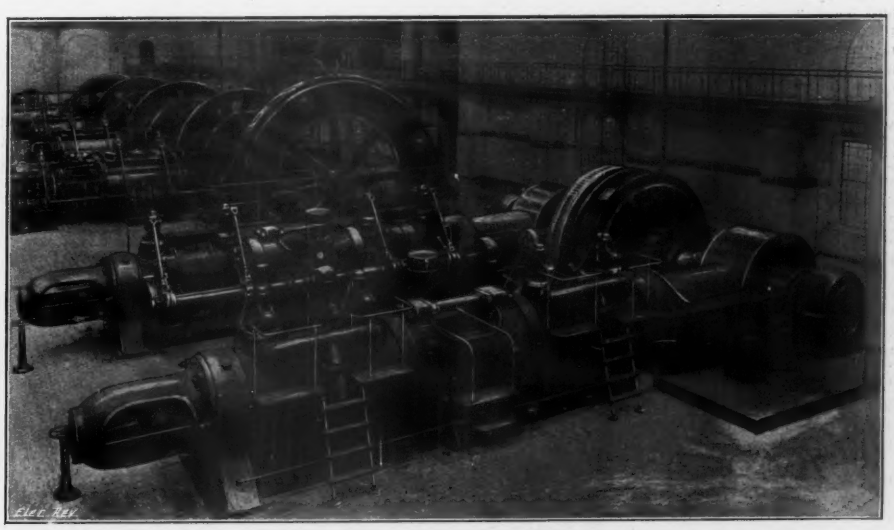

Fig. 55.—Double-Acting Four-Cycle M.A.N. Diesel Engine of 1,600 to 2,000 B.H.P.; Halle Municipal Electricity Works.

Britannia Oil Engines.

The illustration on page 644 shows a four-cylinder 50-B.H.P. paraffin oil engine built by the Britannia Engineering Co (1910), Ltd., of Colchester, for electric lighting purposes. Accessibility has been made the first consideration in the design of this engine, it being possible to remove the crank-shaft, pistons and connecting-rods without dismantling the engine. The casing is a light iron casting with very large doors and covers, but the cylinders are supported on steel columns, which relieve the casing of strains. The cylinders are cast in one piece with the water jackets, which are provided with exceptionally large openings for cleaning purposes. The bearings throughout are lined with white metal, and lubrication is effected by a special system; an oil reservoir is formed in the bed-plate, but the cranks do not dip into the oil. A pump circulates the oil to a spraying device in line with each of the cranks, so that a fine spray of oil is maintained throughout the whole of the crank chamber, thoroughly lubricating all the working parts. This system has been found very successful. High-tension magneto ignition is used by preference. The engine illustrated is provided with a sensitive fly-wheel governor acting on the throttle for electric lighting work, and a plunger pump is employed to circulate the cooling water.

An Italian 1,000-H.P. Diesel Engine and Generator.

One of the striking internal-combustion engine exhibits at the Turin Exhibition last year was a 1,000-H.P. four-cylinder Diesel engine shown by the F.I.A.T. Co., of Turin, directly coupled to an alternator and exciter.

The engine operates on a two-stroke cycle, and has cylinders 550 mm. bore and 800 mm. stroke; the speed is 150 R.P.M., and for short periods a 10 per cent. overload is obtainable.

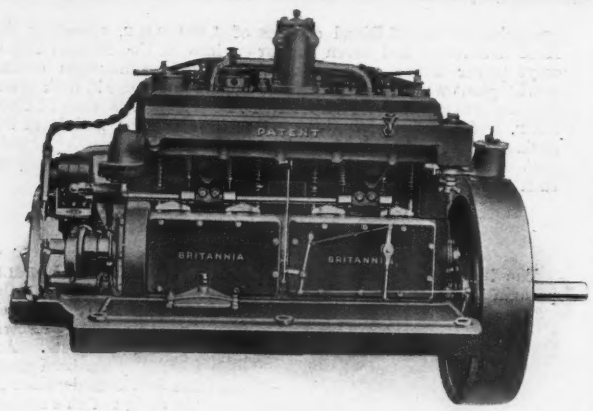

FIG. 56.—BRITANNIA TYPE V.H. FOUR-CYLINDER 50-B.H.P. OIL ENGINE (see p. 643).

The lower portion of the engine consists of an enclosed crank chamber arranged for cooling water circulation, and supporting an upper chamber forming a reservoir for the scavenging air, on which are carried working cylinders combined with scavenging air pumps.

The pistons are each constructed in two diameters, the smaller being the power piston, while the lower annular portion of larger diameter, forces scavenging air into the upper reservoir chamber from which it passes to valves arranged on either side of the injection and starting valves in the cylinder head, and escapes with the burnt gases through ports in the bottom of the cylinders.

The upper chamber also carries a two-stage compressor for supplying the air for starting and pulverising the injected fuel, driven off the main shaft.

The cylinders, covers and their water jackets form one casting, and the upper ends of the pistons are arranged for forced oil cooling; piston pumps, gear driven, are provided for both water and oil circulations.

The primary valves comprising the fuel injection and two scavenger valves in each cylinder head, are operated as a group by one eccentric per cylinder mounted on a horizontal shaft at cylinder level; the shaft also carries cams for operating the starting valves in each cylinder head, and is gear-driven through a vertical shaft from the main crank shaft.

The vertical shaft also drives an intermediate horizontal shaft in the crank chamber for operating a pair of piston valves situated in the upper chamber, and indicated by the bulges below the platform in our view; each of these valves regulates the admission and exhaust from the pair of adjacent single-acting scavenger pumps, which, due to the crank arrangement, are on opposite strokes at any one moment.

A fuel pump is fitted, with an adjustable distributor for the cylinders and hand and automatic regulation, the latter by means of a centrifugal governor.

In connection with the air compressor, arrangements are provided for feeding the air from the scavenger reservoir into the first cylinder of the compressor in order to increase the delivery of compressed air during the period of re-charging the compressed-air tanks for starting. A water-cooler and filter for the lubricating oil, and a filter for the heavy oil are provided.

This engine is started up when cold on light mineral oil or petroleum (·80—·82 density); if hot, it is started on heavy oil.

The fuel consumption, using heavy oil (·92—·94 density) with a calorific value of not less than 18,000 B.TH.U. per lb., is: at full load, ·50 lb. (230 gm.) per B.H.P.-hour; and at ¾ load, ·53 lb. (240 gm.) per B.H.P.-hour. The consumption of lubricating oil is ·033 lb. (15 gm.) per B.H.P.-hour at full load.

The engine above described is of the heavy slow-running type, but the F.I.A T. Co. has given much attention to the design of a high-speed type of Diesel engine for naval use more particularly, and a large number of such engines have been constructed. This type of engine is being used for electrical work, and it represents a considerable saving in weight per H.P. as compared with the low-speed type—the figures being 35 lb. to 45 lb. per H.P., as compared with 80 lb. to 100 lb.

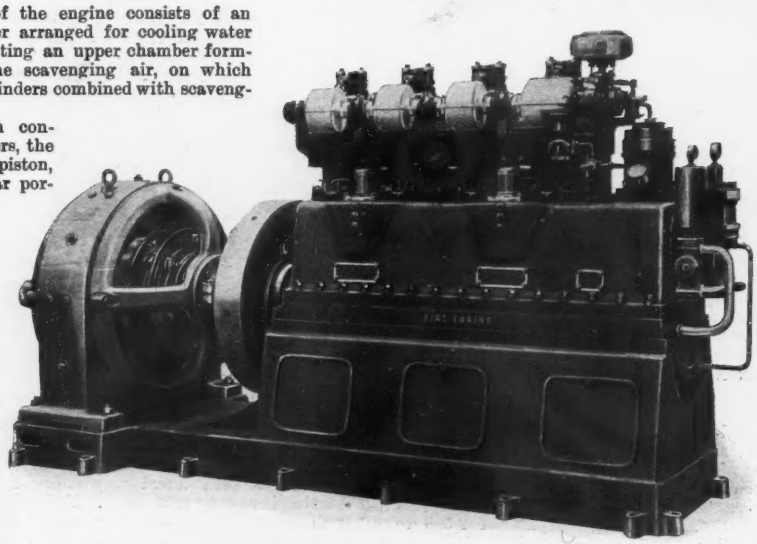

FIG. 57.—F.I.A.T. 200-H.P. TWO-CYCLE HIGH-SPEED DIESEL PLANT.

The company is developing high-speed engines for electrical work in sizes of 500 H.P. to 1,000 H.P.; our second view shows a four-cylinder engine of this type, direct coupled to a dynamo, and having an output of 200 H.P. at 500 R.P.M. In constructive details it follows the larger low-speed engine, but it will be noticed that it is mounted high on a combined bed-plate, which carries the dynamo as well.

In conclusion, we are indebted to Messrs A. G. Graziani & Co., who are agents for the Fabrica Italiana Automobili Torino in this country, and to the latter firm for our information.

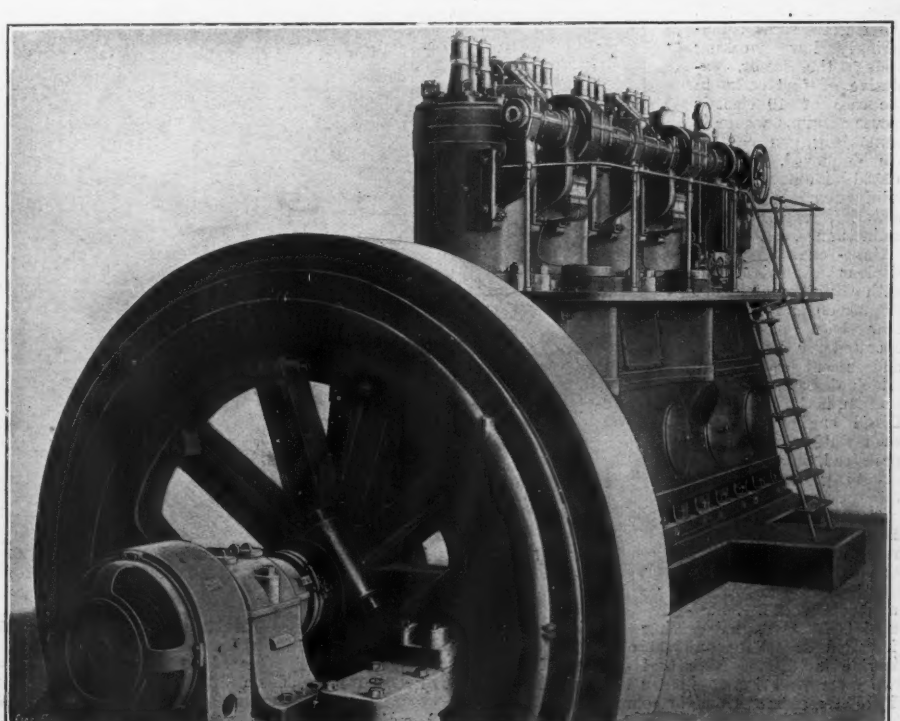

FIG. 58.—F.I.A.T. 1,000-H.P. TWO-CYCLE DIESEL ENGINE AND GENERATOR.

The Lighting of a Scottish Village.

There was recently completed the first section of a scheme for lighting Roslyn Village, Bishopton, N.B. This scheme has been carried out successfully, and is a typical example of what may be done to promote comfort in remotely situated villages of comparatively small population.

Formerly the village had no source of lighting beyond ordinary paraffin lamps. Some years ago, however, a system of petrol gas was introduced, but unfortunately for the promoters, the unsatisfactory light produced created dissatisfaction, and ultimately ordinary paraffin lamps were again brought into use.

Since the introduction of metal-filament lamps, it has been found possible to erect a comparatively small generating station and run it at a profit to the promoters, notwithstanding that a highly efficient system of lighting is made available at a low cost per unit.

Roslyn Village being one of the residential districts of Renfrewshire, and within easy reach of Glasgow, Paisley and Greenock, by rail, the promoters of the village have done all in their power to open up the district for the business men of these towns. The great disadvantage has been the intolerable system of paraffin lighting, and this alone has greatly retarded the erection of new property. Electrical engineers will doubtless be flattered to learn that electric lighting has been the salvation of the landowners, in that it has created a decided demand for land. After the

Village Lighting: Method of Running O.H. Lines.

disappointing experience which the promoters had with other forms of illumination, they were rather reluctant to move in any new venture without absolute assurance of success, but after long deliberation with a Glasgow expert, the promoters got into touch with the makers of the Gleniffer electric lighting sets, Messrs. John Scott Engines, Ltd., Lonend Motor Works, Paisley. This firm, who make a speciality of country house and estate lighting, went into the proposed electric lighting scheme, with the result stated. The power house at present erected consists of a substantial brick building and concrete work, and is divided into three sections, these being engine house, battery room and workshop.

The transmission cables are run overhead on poles, and the services are tapped where necessary *en route*.

The wiring of the residences, like the supply of the energy, lies entirely with the promoters, and Messrs. John Scott Engines, Ltd., have been responsible for this part of the work also.

During the past few months careful records have been kept, and in the result it has been found that the working cost has been about 1d. per B. of T. unit, including all charges, whilst the price obtained is 4½d. per B. of T. unit. The fuel employed is ordinary paraffin, and the consumption per brake-horse-power-hour is about ·7 pint.

We understand that the firm named above have their engines at work in all parts of the world, and at present they have many months' work in hand, including a plant for another village lighting scheme, in England.

CONTRACTS OPEN.

(*Continued from page* 624.)

Bray (Ireland).—May 7th. One 150-B.H.P. Diesel engine, coupled to a 100-kw. alternator and exciter, and one 7½-ton overhead crane, for the U.D.C. See "Official Notices" April 12th.

Cape Town.—May 15th. Two electric passenger lifts for new Law Courts. Specifications, &c., from District Engineer, Public Works Dept. Deposit £2.—*Board of Trade Journal.*

A copy of the specification may now be seen at the Com. Int. Department of the Board of Trade in London.

May 9th.—Cape Town City Council.

A steam turbine-driven alternator and converter, the turbine to be capable of giving a continuous output of 2,000 K.V.A.
Approximately 24,750 yards of E.H.T. three-phase cable, joint boxes and disconnection pillars.
Green economiser.

Tenders are to be deposited at the City Hall, Cape Town.

Falkirk.—May 6th. Stores for a year, for the Burgh Electricity Department. See "Official Notices" to-day.

Felixstowe.—April 22nd. Replacing 40 arc lamps by glow lamps, for the U.D.C. See "Official Notices" April 12th.

Glasgow.—The Parish Council invites tenders for electric lighting and telephone installation for the new epileptic colony at Chryston. J. R. Motion, clerk.

Gravesend.—April 29th. Cables, for the Corporation. See "Official Notices" to-day.

Heston and Isleworth.—May 8th. 500-kw. steam engine, D.C. generator, balancer, &c., water-tube boiler, chain-grate stoker, pipework, &c., surface condenser, air pump, &c., for the U.D.C. See "Official Notices" to-day.

Hoylake and West Kirby.—May 6th. One Lancashire boiler, with superheater, &c., vertical steam pump and self-acting re-starting injector, for the U.D.C. Electricity Works. See "Official Notices" to-day.

Italy.—April 30th. The Italian State Railway authorities in Rome are inviting tenders for 30 electric motors for the Rome-Trastevere railway workshops.

Japan.—H.M. Vice-Consul at Osaka reports that the appropriations for the financial year 1912-13 for the Osaka municipal electric tramways will permit of the extension of the system for about six miles, and that in order to carry out this work it will be necessary to place abroad large orders for material, the aggregate value of which is estimated at about £408,000. Some of the principal items will be rails, electric motors, brakes and other car stock (bodies are made in Japan), other machinery, insulated copper wire and insulating fabric, &c. Particulars, Board of Trade Commercial Intelligence Department.

Leeds.—April 20th. Eight miles of ·2 sq. in. three-core cable, 6,600 volts, for the City Council. See "Official Notices" April 5th.

Lincoln.—May 6th. One 1,000-H.P. Diesel oil engine, coupled to a continuous current dynamo, or two 500-H.P. Diesel engines, with continuous current dynamos; one 120-kw. motor-generator and one switchboard, for the Corporation. See "Official Notices" April 12th.

London.—Hackney.—May 9th. High and low-tension cables, boxes, frames and covers, troughing, ducts, &c., for the B.C. Electricity Department. See "Official Notices" to-day.

Islington.—May 1st. Electrical fittings and sundries, for the St. Mary B.G. See "Official Notices" to-day.

New Zealand.—May 1st and July 1st. Public Works Department. Supply of machinery and material for the Lake Coleridge electric power scheme. See this column in our issue of April 12th.

Salford.—April 22nd. Electrically-operated travelling jib crane, bulk weigher, and tray conveyor, for the Corporation Electricity Department. See "Official Notices" April 12th.

Southampton.—April 27th. Main cables, switchboard panels and electric lighting of the new buildings at Shirley Warren Poor Law Infirmary for the B.G. See "Official Notices" to-day.

Southend-on-Sea.—Stores for a year, for the Corporation Electricity Department. See "Official Notices" April 12th.

Walsall.—April 22nd. Seven tramcar bodies, with trucks and equipment, for the Corporation. See "Official Notices" March 29th.

CLOSED.

Admiralty.—A contract for all fuses required of 35 amperes capacity and above, and for a portion of their requirements of 10 to 30-ampere fuses, has been placed with the Electrical Apparatus Co., Ltd.

Ashton-under-Lyne.—The Corporation has accepted the following tenders for the tramway undertaking:—

British Insulated & Helsby Cables, Ltd.—Trolley wire.
Watlington & Co.—Overhead line material.
W. B. Haigh & Co.—Band saw.

Clacton-on-Sea.—The U.D.C. has accepted the tender of Messrs. Johnson & Phillips, Ltd., for lamps, &c., for lighting the sea front:—

Twenty 10-ampere arc lamps, £190; line resistances, £3; columns and cables, £1,004; less £25 if the contract as a whole is carried out at one time; total, £1,171.

Croydon.—The Corporation has placed the contract for carbon filament lamps (Ruby), tantalum traction lamps for car lighting, and "Wotan" metal filament lamps for the ensuing 12 months with Messrs. Siemens Bros. Dynamo Works, Ltd.

Fleetwood.—For oil and packing for the electricity works, the tender of Messrs. J. Preston & Sons has been accepted.

Glasgow.—In connection with the plant to be put down in the new sub-stations in the Whitevale, Trongate and Maryhill districts, the Electricity Committee recommends the acceptance of the following offers:—(1) by Siemens Bros. Dynamo Works, Ltd., for three 250-KW. rotary converters, with transformers, at £1,820; (2) by the British Westinghouse Electric and Manufacturing Co., Ltd., for one 500-KW. rotary converter, without booster, at £1,266; and (3) by the British Thomson-Houston Co., Ltd., for two 500-KW. rotary converters, with booster and transformers, at £2,649.

The Electricity Committee recommends the acceptance of the following:—

Storage battery.—Tudor Accumulator Co., Ltd.
Motor generator and switchboard.—Crompton & Co., Ltd.
Car motors.—British Westinghouse Co., Ltd.
Dry cells.—Wm. McGeoch & Co., Ltd.

Isle of Thanet.—The Joint Hospital Board has renewed the contract with Messrs. Vitty & Hopper, of Ramsgate, for inspecting and maintaining the electric bells and ward telephones at the hospital.

London.—GREENWICH.—The B.C. has accepted the tender of Messrs. Frankland, Phillips & Co., of Poplar, for erecting lightning conductors on the mortuary chapels at the cemetery at Greenwich, and repairing that on the church at Charlton Cemetery.

Londonderry.—The Corporation has accepted the tender of the Reason Manufacturing Co. for the supply of fuse-boxes for the current year.

Lowestoft.—The tender of Messrs. Lleipzieger & Co. has been accepted by the T.C. for the supply of tramway rails at £8 3s. per ton.

Sheffield.—The tender of the British Electric Transformer Co., Ltd., has been accepted by the T.C., at £1,051 10s., for two sets of three-phase transformers.

Southampton.—Messrs. Siemens Bros. Dynamo Works, Ltd., have received the Harbour Board contract for "Wotan" metal filament lamps, tantalum lamps, carbon filament lamps (high voltage), opal shades and enamelled iron shades.

Stafford.—The T.C. has accepted the tender of Messrs. Green & Sons for an economiser for the electricity works, at £231.

Stockport.—The T.C. has accepted the following tenders:—

Cotton & Rawcliffe.—Electric wiring (Gas Committee), £81 15s.
E. Green & Sons, Ltd, Wakefield.—Two patent fuel economisers, £567.
Alphons Custodis Chimney Construction Co., London.—Chimney for the electricity works, £869 10s.
McClure & Whitfield.—Electric light installation at the hospital, £358 10s.
W. A. Shaw & Co.—Telephone installation at the hospital, £28 5s., and electric bells for schools, £16 5s.
J. W. Gray & Son, London.—Lightning conductors for schools, £24.

Walsall.—The T.C. has accepted tenders of the British Thomson-Houston Co., Ltd., and Brooks & Orton for the supply of a 3½-H.P. motor, including starter, and the necessary timber for tramway car tops at £15 and £94 respectively.

Wednesbury.—The T.C. has entered into an agreement with the Tudor Accumulator Co., Ltd., for the maintenance of the storage battery for 10 years from January 1st, 1912.

West Bromwich.—The T.C. has accepted the tender of Messrs. Richardsons, Westgarth & Co., Ltd., for a surface condenser for a 1,000-KW. turbo-alternator.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued:—

Friday, April 19th.—"D" Company. Infantry drill, 7.30 to 8.30 p.m. Technical work, 8.45 to 10 p.m. Recruit instruction, 7 to 10 p.m.

Saturday, April 20th.—Annual course of musketry, at Purfleet. Railway tickets and information regarding train service will be sent to members notifying their willingness to shoot on this date. Headquarters will be open for regimental business from 10 a.m. till 12 noon.

Monday, April 22nd.—"A" Company. Infantry drill, 7.30 to 8.30 p.m. Technical work, 8.45 to 10 p.m.

Tuesday, April 23rd.—"B" Company. Infantry drill, 7.30 to 8.45 p.m. Technical work, 8.45 to 10 p.m. Recruit instruction, 7 to 10 p.m.

Thursday, April 25th.—"C" Company. Infantry drill, 7.30 to 8.45 p.m. Technical work, 8.45 to 10 p.m.

Friday, April 26th.—"D" Company. Infantry drill, 7.30 to 8.30 p.m. Technical work, 8.45 to 10 p.m. Recruit instruction, 7 to 10 p.m.

(The infantry drill in all companies is in preparation for the Officers' Cup competition.)

Saturday, April 27th.—Headquarters will be open from 10 a.m. till 12 noon.

(Signed) P. H. CAMPBELL, Capt. R.E., and Adjt.,
For Officer commanding L.E.E.

FORTHCOMING EVENTS.

Royal Institution.—Friday, April 19th. At 9 p.m. Discourse on "Electricity Supply: Past, Present and Future," by Mr. A. A. Campbell Swinton.
Thursday, April 25th.—At 3 p.m. Lecture on "Synthetic Ammonia and Nitric Acid from the Atmosphere," by Prof. A. W. Crossley.

Association of Engineers-in-Charge.—Saturday, April 20th. Social. Bohemian concert.

Faraday Society.—Tuesday, April 23rd. At 8 p.m. At the I.E.E., Embankment, W.C. General discussion on "Magnetic Properties of Alloys."

The "25" Club.—Wednesday, April 24th. At 7.15 p.m. Dinner at the Waldorf Hotel, Aldwych, W.C.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, April 24th. At 7.30 p.m. At the University, Birmingham. Paper on "Yellow Flame Arcs," by Mr. M. Solomon.

Institution of Electrical Engineers (Students' Section).—Wednesday, April 24th. At 7.45 p.m. Annual general meeting. Paper on "Homopolar Generators," by Messrs. E. W. Moss and J. Mould.

Association of Mining Electrical Engineers (North of England Branch).—Wednesday, April 24th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on "Fault Location on Mining Cables," by Mr. G. B. Burrows; and (time permitting) discussion on paper on "Motor Starters for Mining Work," by Mr. A. P. Drake.

Royal Society of Arts.—Wednesday, April 24th. At 8 p.m. Paper on "Technical Education in Ireland," by Mr. G. Fletcher.

Institution of Electrical Engineers (London).—Thursday, April 25th. At 8 p.m. Third Kelvin Lecture, by Prof. H. du Bois.

Physical Society.—Friday, April 26th. At 5 p.m. At the Imperial College of Science, South Kensington. Papers on "The Solution of Network Problems by Determinants," by Mr. R. Appleyard; and "A Method of Measuring Small Inductances," by Mr. S. Butterworth.

Junior Institution of Engineers.—Saturday, April 27th. At 3 p.m. Visit to the engineering workshop and laboratory and the electrical laboratory of the Polytechnic, Regent Street, W.

NOTES.

To the Benevolently Disposed.—Don't forget to attend the Festival Dinner of the Electrical Trades Benevolent Institution on Wednesday next at the Hotel Cecil! Tickets from the secretary, 10s. 6d. each.

Electrical Strike at Earl's Court.—A dispute having arisen between some of the members of the Electrical Trades Union and the Earl's Court Exhibition Co., regarding the rate of pay for work on Easter Monday, a strike has been in progress for some days in which the electrical workers have the sympathetic support of the London Building Industries Federation, and on Monday night 500 men working at the Exhibition handed in their notices. Mr. Webb, the Union Secretary, informs us that the men's case is as follows:—Members of the Union to the number of 70 out of about 100 electricians employed, worked on Good Friday and the following day, and were asked to do so on Easter Monday at ordinary time rates. As, however, the trade card says that time and a half must be paid for Bank Holidays, members declined to work. On presenting themselves on the Tuesday morning, known E.T.U. men to the number of 30 were locked out, and at a meeting held in the dinner hour, the remainder of the Union men came out in sympathy. We are informed by Mr. Webb that at a meeting between a deputation of the London Building Industries Federation and the Earl's Court directors on Thursday, last week, the directors agreed to reinstate all the Union members on the Friday morning, but on presenting themselves on that day only 15 were wanted. The men regarded this as a direct violation of the agreement, and they declined to work. The sequel was a meeting summoned for midday on Monday at Richmond Place, West Kensington, Earl's Court, for workmen "to consider whether they are prepared to work with scabs." The meeting was addressed by Tom Mann, and the upshot was that the 500 building trade workers "downed tools." Tom Mann, in a characteristic speech, said that the dispute gave another opportunity to demonstrate the solidarity of labour, and he urged the workers to take formidable action during 1912 against the employers. He said that there was no reason why any man should work more than six hours per day or receive less than 40s. a week.

As we go to press we learn that the strike was settled on Wednesday; all strikers were to be reinstated, and only union men to be employed.

Appointments Vacant.—Senior meter room assistant, for the Stepney B.C. Electricity Department; overhead wireman, for the Bolton Corporation Tramways; two test-room assistants, for the Marconi Co.'s Chelmsford Works; station fitter, for the City Electricity Department, Winchester (50s.). See our advertisement pages to-day.

Erratum.—In the second line of the last paragraph of Mr. Chas. Bright's article on "Trans-Atlantic Telegraphy," on page 564 of our issue of April 5th, the word "important" should have read "impartial."

O.S.A. Smoking Concert.—The second joint smoking concert of the Old Students of the Central Technical College and Technical College, Finsbury, will be held in the Crown Room, Holborn Restaurant, on Wednesday evening next, commencing at eight o'clock. Mr. R. J. Wallis-Jones will preside, and many well-known artistes, including Miss Katie Moss, Mr. Conway Dixon, Mr. Tom Kinniburgh, Miss Lois Barker, Mr. Bradley Alexander, Mr. Wilson Martell, Mr. Walter Walters, and others, will appear. Tickets, 1s. each, may be obtained from the concert secretary, Mr. John E. Raworth, Queen Anne's Chambers, 28, Broadway, Westminster, S.W.

London Chamber of Commerce. — The thirtieth annual general meeting of the London Chamber of Commerce was held at the Cannon Street Hotel, E.C., on Thursday, April 18th. The report submitted by the Council included the following dealing with the Electrical Trade Section :—

National Insurance Bill.—It was decided to co-operate with the Manufacturers' Section in this matter in view of the interests of the two bodies being identical. A resolution setting forth the undesirability of the Bill being pressed forward in the 1911 Session, was also adopted.

International Electro-Technical Commission.—The invitation of the International Congress on the Application of Electricity, to appoint representatives to attend the Congress, held at Turin in September, was accepted, and the chairman of the Section (Mr. C. P. Sparks), Mr. A. Bruce Anderson, and Mr. Leon Gaster were nominated to represent the Section. The report of the delegates will be received and considered at a future meeting of the Section.

Electricity in Mines.—The report of the Departmental Committee on Electricity in Mines was considered at a meeting of the Section. It was arranged that if a public inquiry took place, the Section would arrange for its views to be put forward by technical experts in a similar manner to action taken in previous years in connection with regulations relative to electricity in factories.

Electrifying the East.—Attention was called to the efforts made by the German electrical industry to secure the control of trade with China, Japan, and the Far East, and the Manufacturers' Section was requested to consider the questions raised in connection with the German enterprise in the electrical industry, it being further suggested that it was desirable that the Government should appoint Commercial Attachés to safeguard the interests of manufacturers of electrical plant and appliances.

Other Matters.—Many matters of interest to the industry were dealt with in correspondence with members, while the Section was represented on Special Committees appointed by the Council in connection with trade disputes and misrepresentations in trade.

Institution and Lecture Notes.—Iron and Steel Institute.—The annual meeting of the Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday, May 9th and 10th. The president-elect is Mr. Arthur Cooper. On the Thursday the Bessemer Gold Medal for 1912 will be presented to Mr. J. H. Darby, and the president will deliver his inaugural address. A selection of papers will be read and discussed in the morning and afternoon, and at night the annual dinner will take place at the Connaught Rooms, Great Queen Street, W.C.

On Friday the Andrew Carnegie Gold Medal (for 1911) will be presented to Dr. P. Goerens (Aachen) and the award of Research Scholarships for the current year will be announced. A further selection of papers will then be read and discussed. The following are included in the list of expected papers :—

"On the Chemical and Mechanical Relations of Iron, Vanadium, and Carbon," by Dr. J. O. Arnold (Sheffield) and Prof. A. A. Read (Cardiff).
"The Influence of Carbon on Corrosion," by C. Chappell (Sheffield).
"The Corrosion of Nickel, Chromium, and Nickel-Chromium Steels," by Dr. J. N. Friend, J. Lloyd Bentley, and W. West (Darlington).
"On the Mechanism of Corrosion," by Dr. J. N. Friend, W. West, and J. Lloyd Bentley (Darlington).
"Modern Rolling-Mill Practice," by J. W. Hall (Birmingham).
"The Influence of Heat on Hardened Tool Steels," by E. G. Herbert (Manchester).
"Improvements in Electric Steel Furnaces and their Application in the Manufacture of Steel, by Dr. H. Nathusius (Friedenshütte, Upper Silesia).

South African Institute of Electrical Engineers.—At the annual general meeting on January 18th, it was reported that the total membership amounted to 270, an increase of 65 during the year, and the balance-sheet showed cash assets £168. Mr. J. H. Rider was re-elected president, and Mr. B. Price vice-president, the second vice-president elected being Mr. W. Elsdon-Dew. The president then gave a lecture on "The Electrical System of the London County Council Tramways," illustrated with lantern slides.

Institution of Electrical Engineers.—The following are the Council's nominations for election of Council for the year 1912-13, which were announced at the meeting yesterday :—

President.

W. Duddell, F.R.S., New nominee.

Vice-Presidents.

W. Judd, C. H. Merz, New nominees.

Major W. A. J. O'Meara, C.M.G. ; J. F. C. Snell, Remaining in office.

Honorary Treasurer (retires annually and is eligible for immediate re-election).

Robert Hammond, New nominee.

Members of Council.

F. Gill, A. Russell, D.Sc., W. Rutherford, A. H. Seabrook, Roger T. Smith, New nominees.

H. Dickinson, J. S. Highfield, H. Hirst, B. M. Jenkin, J. E. Kingsbury, P. V. McMahon, R. K. Morcom, S. L. Pearce, H. Faraday Proctor, C. P. Sparks, Remaining in office.

Associate Members of Council.

A. B. Anderson, New nominee.

S. Morse, H. E. Wimperis, Remaining in office.

Legal.—Gott *v.* Veritys, Ltd. — On Wednesday the Court of Appeal, composed of Lords Justices Vaughan Williams and Fletcher Moulton and Mr. Justice Parker, disposed of an appeal by the defendants in this case from a ruling of Mr. Justice Lush. The action was brought by Mr. Arthur Edgar Gott, electrical engineer, of Southall, Middlesex, against Messrs. Veritys, Ltd., electrical engineers and manufacturers, of Aston, Birmingham. When the case came for trial at the Birmingham Assizes, Mr. Justice Lush referred the whole matter to the Official Referee, at the same time, it was asserted, making a declaration as to the proper construction of the contract sued upon. It was against this so-called declaration by the learned Judge that the defendants now appealed, and asked that the action should be dismissed with costs.

The plaintiff's case was that by a contract contained partly in an agreement in writing, dated April 9th, 1907, between the parties and partly in two letters dated November 5th, 1908, from the defendants to the plaintiffs, it was agreed that the defendants should manufacture and sell certain patented articles of which the plaintiff was the inventor, and further pay the plaintiff certain royalties. It was a term of the contract, plaintiff said, that in the event of the defendants desiring to discontinue the manufacture and sale of any of the articles they should give the plaintiff three months' notice in writing to that effect. Plaintiff alleged that in November, 1908, the defendants, without giving notice, discontinued the manufacture of the articles, and subsequently discontinued the sales when the stock became exhausted, thereby causing him loss.

The defendants, while admitting the existence of a contract, denied that its terms were properly set out by the plaintiff. They further said that the contract properly construed did not impose on them any obligation to manufacture or sell the patented articles ; and that, in fact, they gave proper notice determining the contract.

The appellants now contended that Mr. Justice Lush, in referring the action, was wrong in holding that the defendants were under any obligation expressed or implied to manufacture and sell the articles in question.

In the course of the arguments, Lord Justice Vaughan Williams said that, in his opinion, there was no declaration of law on the question of construction by Mr. Justice Lush, and he did not think that the learned Judge intended to make any declaration. In those circumstances there was no order which was being appealed against.

Mr. Hugo Young, K.C. (for the plaintiff), asked what was to become of Mr. Justice Lush's judgment.

Mr. Justice Parker did not think the judgment ought to be treated as binding on any matter of law.

Mr. Vachell, K.C. (for the defendants), agreed that when the case came before the Official Referee, Mr. Justice Lush's judgment, so far as it purported to construe the contract, ought to be put on one side altogether.

Mr. Justice Parker : The Official Referee can find the facts, and make his award in the form of a special case.

Lord Justice Moulton : Or report to the Court.

Mr. Hugo Young said that that would mean exposing the plaintiff to a good deal of expense when a possible result was that the Court, in the long run, would say that there was no case at all.

Lord Justice Moulton said that in the absence of any order declaring something as to the rights of the parties, this Court could not help the plaintiff.

Mr. Hugo Young : Would it not be advisable to get Mr. Justice Lush to draw up a declaration ? At present I am deprived of my right to go before the Official Referee supported by the learned judge's judgment.

Lord Justice Vaughan Williams : It is possible that you will convince the Official Referee as successfully as you convinced Mr. Justice Lush.

After some further discussion, it was arranged that the case should go to the Official Referee, neither side being at liberty to refer to the judgment of Mr. Justice Lush or to the remarks which had fallen from the judges in this Court. Plaintiff was given leave to amend his pleadings as to the alleged breaches of contract, the same privilege being extended to the defendants, should it become necessary to amend their defence. The costs of the present appeal were made costs in the cause.

Electrical Rifle Club.—It has been suggested to us that it would be desirable to form a rifle club in connection with the electrical trade. We shall be glad to receive names and suggestions from those interested, which may be addressed to the Secretary *pro tem.*, The Electrical Rifle Club, at these offices.

Parliamentary.—In the House of Commons on Monday the Light Railways Bill was read a second time.

The B.A. Meeting at Dundee.—This year's meeting of the British Association takes place at Dundee from September 4th to 11th, with Prof. E. A. Schäfer, LL.D., F.R.S., Professor of Physiology at Edinburgh University, as President. Section A will be under the chairmanship of Prof. H. L. Callendar, LL.D., F.R.S., and the Engineering Section (G) will be presided over by Prof. A. Barr, D.Sc. Among the arrangements announced is an evening discourse by Prof. W. H. Bragg, F.R.S., on "Radiations Old and New."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements*

Central Station Officials.—At a smoking concert recently held at the Napier Arms Hotel, Mr. F. T. Woodward, commercial assistant to the Gillingham borough electricity department, was presented with a gold half-hunter watch, subscribed for by

the staff, workmen and others. Councillor Naylor presided, and among those present were Mr. A. D. Chalmers, borough electrical engineer, Mr. A. J. Ryan, deputy electrical engineer, and Messrs. F. Walker (secretary) and C. B. Nadaud, who represented the Kent Electric Power Co. Mr. Woodward, in responding, congratulated the Council upon having so loyal and contented a staff, which was one of the best assets that such an undertaking could have.

Mr. Harold C. Holroyd has resigned his position as engineer-in-charge at the Portsmouth Corporation electricity works in order to take up a post with Messrs. Willans & Robinson, Ltd., Rugby.

On April 4th, Mr. A. H. Smith was presented by the staff of the Whitehaven Corporation electricity works with a travelling bag on the occasion of his leaving to take the post of shift engineer at the Crewe Corporation electricity works. On April 11th, Mr. R. H. Sanderson, junior clerk, who is also leaving the Corporation service, was presented with a gold-mounted fountain pen.

Mr. L. G. Dimmer, charge engineer at the Cheltenham electricity works, has resigned, and is leaving for Canada, and Mr. J. L. H. Cooper has been appointed in his place. Mr. H. W. Hartnell, the mains superintendent, who has, with the exception of 11 months, been in the employ of the Corporation ever since the undertaking was inaugurated, has also resigned, and is going to Canada. Mr. C. G. Smith, who has been charge engineer at the works for four years, and has had experience of mains work elsewhere, has been promoted to the post. The vacancy caused by Mr. Smith's promotion has been filled by the appointment of Mr. G. Waring. Mr. J. M. Robb, assistant engineer, and Mr. C. T. Bastin, chief clerk and accountant, have both had their salaries increased.

The Doncaster T.C. has increased the salary of the electrical engineer by £25, with a further similar increase next year.

General.—Mr. W. H. Alcock, engineer to Messrs. Jenkins & Co., engineers, &c., Cape Town, leaves South Africa by the Union Castle ss. *German* on April 22nd, for six months' holiday. Mr. Alcock's postal residential address will be, care of Mr. H. Davies, Stubenville, Llandudno, North Wales.

Mr. B. L. Tregoning, late of the L. & Y. Railway power station, Formby, has accepted a position as constructional engineer with the Central Argentine Railway, Ltd., and sails on April 26th in the R.M.S. *Araguaya*.

The Sowerby Bridge U.D.C. has appointed Mr. W. H. Holroyd, of Carnforth, as electrician at the gas works.

The Salford Corporation has retained the services of Mr. E. M. Lacey, consulting engineer, of Manchester and Westminster.

A correspondent writes:—"One of the passengers on board the *Titanic* was Mr. W. H. M. Parr, of Horwich, near Bolton, who was formerly employed in the electrical department of the Lancs. and Yorks. Railway Co.'s locomotive works at Horwich. Some three years ago, Mr. Parr was appointed to a managerial position at Messrs. Harland & Wolf's shipbuilding works at Belfast, builders of the *Titanic*, and in that capacity had superintended the electrical equipment of the great liner. He was accompanying her on her maiden voyage as the representative of the builders to supervise the working of the electrical plant, having a staff of workmen with him."

In the *Times* list of the principal officers of the *Titanic*, the following electricians are mentioned: B. Sloan, 31, Southampton, chief electrician; A. S. Alsopp, 34, Southampton, second electrician; H. Jupe, 29, Southampton; A. Middleton, 26, Sligo; and A. Ervine, 22, Belfast, assistant electricians. F. G. Phillips, 24, Godalming, and H. St. Bride, 25, Southampton, telegraphists, were also on board.

According to the *Daily Mail*, a Mr. Sedgwick, formerly an engineer at St. Helens Electricity Works, who was going to Mexico to take up an appointment, was one of the passengers on the *Titanic*. He was married only a week before he left England, and left his wife at home.

CITY NOTES.

Indian Electric Supply and Traction Co., Ltd.

Mr. J. G. B. Stone presided at the annual meeting held on Wednesday at the offices, Orient House, New Broad Street, E.C.

The Chairman, in moving the adoption of the report, said when they met last year he was able to report that material progress had been made; sales of current were larger, and an increased profit had been secured. He was in a position to-day to say that in both respects further advances had again been made, the sales of current had risen from 516,000 units in 1910 to 813,000 in 1911, and the gross receipts from £8,056 to £10,974. The connections to the mains increased during the year from the equivalent of 21,104 lamps to 28,739, and now exceeded 30,000. Owing to the larger proportion of current being supplied for power purposes, the average sale price per unit had receded from 2·84d. in 1910 to 2·69d. in 1911; but, on the other hand, the generating costs had fallen from 1·16d. to 1·03d. per unit. With regard to the small length of tramway, they had carried a larger number of passengers on a reduced number of cars, and the earnings per car-mile were 4·62d., as against 4·17d. On the other hand, maintenance was higher, and, consequently, the net result was practically the same as last year. What they called the sales department, i.e., the wiring of customers' premises, sales of appliances, and income from the workshop, last year yielded a profit of £600—this department was instituted on account of the lack of satisfactory wiring contractors in Cawnpore, and it had fully justified its existence, seeing that, apart from the actual profit earned, it had to a material extent assisted in the expansion of the business. The total profit for the year, including £402 received for interest on deposits with the bank and agents, was £7,388, of which £2,700 was required to meet interest on debentures, and there remained £4,687, which had been applied in reduction of the debit balance which had accumulated in profit and loss account during the early stages of the company's working. He must, however, remind them that no reserve on account of depreciation had yet been possible. The growth of the business was steady if somewhat slow, and there was a prospect of selling one or more large blocks of current for power purposes. During the year they had expended £4,151 on capital account. Of this, £1,658 represented the cost of a new boiler, and the remainder mains and house connections. They also purchased from the Government of India one of the 600-kw. Belliss-Siemens generating sets which had been used for a few weeks only at the Delhi Durbar, at about 60 per cent. of what it would have cost them to send out a similar set from England. Payment for this fell within the current year. It was probable that another boiler and some further expenditure in the generating station for condensing plant would be required, and also for a short length of tramway through a new street which was on the point of being opened up to Surseya Ghat. They would have noticed in the balance-sheet a contingent liability for three years track rent due to the Cawnpore Municipality, of £1,101. Since the report was issued they had heard that the Municipality were willing to reduce their claim for annual track rent from Rs. 2,250 and Rs. 1,500 per mile of double and single track respectively, to Rs. 1,000 to Rs. 700, with retrospective effect. Thus this contingent liability would be reduced to less than one-half. They were glad to say the general condition of the United Provinces was now one of material prosperity, and it was expected that the harvest for the present year would be a record one. This was an important factor, as it increased the spending power of the population which they served. The outstanding debentures fell due to be paid off at the end of the current year, and the board were giving this matter serious attention. Their object was to reorganise the finances of the company in such manner as to render available for distribution in dividends a portion of the steadily increasing profits.

Mr. K. A. Scott Moncrieff seconded the motion, and the report was adopted without discussion.

Canadian and American Westinghouse Companies.

—According to the financial Press, the report of the Canadian Westinghouse Co. for 1911 shows net earnings amounting to $1,010,200, as against $697,400 for 1910. The dividend has been raised from 7 to 8 per cent., while $100,000 has been written off against depreciation reserve, a similar sum having been dealt with in this manner 12 months ago; $50,000 is now transferred to inventories adjustment reserve, an increase of $20,000, and a new item is the transfer of $50,000 to insurance fund. There remains a surplus of $160,000, of which $135,800 has been written off in respect of property and plant, the corresponding figure at this time last year having been $70,500, leaving $324,200 to be carried forward, as against $190,500 at the end of 1910. The directors of the American Westinghouse Electric and Manufacturing Co. have just declared a dividend of 1 per cent. on the common shares for 1911, being the first distribution on this issue since the reorganisation of the company in 1908. The directors will not consider the question of any further dividend until the expiry of six months. They have been induced to adopt this course in view of the uncertainties with which they are surrounded, while they have also to consider the obligations which will mature in due course, while, finally, in order to extend the business, it is necessary to conserve all available resources.

Indo-European Telegraph Co., Ltd.—The directors, subject to final audit, recommend a dividend for the six months ending December 31st, 1911, of 17s. 6d. per share (making, with the interim dividend already paid, 6 per cent. for the year) and a bonus of 20s. per share, both free of income-tax. They also recommend a special distribution of 15s. per share, free of income-tax, out of interest accrued during the year upon certain investments and advance accounts. The dividend, bonus and special distribution will be payable on May 1st. The transfer books are closed until April 26th.

British Columbia Electric Railway Co., Ltd.—The directors have declared an interim dividend at the rate of 8 per cent. per annum, payable on April 30th, on the deferred ordinary stock, for the half-year to December 31st, 1911.

British Electric Traction Co., Ltd.—It is announced that the directors have declared an interim dividend of 3 per cent. on the 6 per cent. cumulative preference stock on account of the year ended March 31st, 1912.

Monte Video Telephone Co., Ltd.—The directors have declared interim dividends for the half-year to January 31st at the rate of 5 per cent. per annum on the preference shares and 6 per cent. per annum on the ordinary shares.

Montreal Light, Heat and Power Co.—The directors have declared a dividend of 2 per cent. on the paid-up capital stock (being at the rate of 8 per cent. per annum) for the quarter ending April 30th.

Tynemouth and District Electric Traction Co., Ltd.

The directors' report for 1911 states that the total revenue amounted to £14,070, as compared with £12,723 for 1910. After deducting all expenses chargeable to revenue, including repairs and maintenance, and interest on debentures, and placing a sum of £600 to renewals account, there remains a surplus of £5,245, plus £187 brought forward, making an available balance of £5,433. The directors recommend that there should be placed to reserve account £1,000, to sinking fund for debenture redemption £500, preference dividend, 5 per cent., £1,525, dividend on the ordinary shares at the rate of 4 per cent. per annum £1,856, carrying forward £551. The reserve funds of the company will then be :—Reserve account £8,000, sinking fund for debenture redemption £6,332, renewals account £2,900. The expenditure on capital account during the year was £78, making the entire outlay £97,993. As a result of the very fine summer the net revenue showed an increase of £326. One car was re-roofed and fitted with top seats and new staircases during the year. All the company's cars have now been entirely re-roofed.

	1910.	1911.
Miles open—Route miles	4·21	4·21
Single line	·59	·59
Double line	3·62	3·62
Passengers carried	2,056,800	2,098,959
Av. traf. rec. per passenger	1·53d.	1·53d.
Av. expen. per passenger	·88d.	·87d.
Proportion of expenses to receipts ..	58 %	56 %
Cars in stock, including water car..	22	22

The meeting was held at the Electrical Federation Offices, Kingsway, W.C., on Tuesday, Mr. H. S. Day presiding.

The Chairman said that the revenue generally was up a matter of £340, and the expenses were also up slightly. The figure they had to look to, however, was the carry forward, which this year, after paying the same dividend as last year, was £551, against £187. The directors went carefully into the question of enhancing the dividend on the ordinary shares, but looking to the unrest there was in the country at present, and the fact that a very small margin would be left, they felt they would be wise to keep to the 4 per cent. until they were in a stronger position. The reserve fund and sinking fund, after giving effect to the recommendations in the report, would be £17,232. It was not as much as they would like to see, but, after all, it was very satisfactory, considering the competition they had to meet from the North-Eastern Railway. With regard to the strike, it was interesting to remark that it had actually helped their revenue, for they had pulled up £120 in the last few weeks in consequence of the shortage of the North-Eastern Railway train service.

Mr. C. Shirreff Hilton seconded the motion, and the report was adopted.

The retiring directors were re-elected, and the remuneration of the board fixed at £50 for the chairman and £25 each per annum for the other members.

Anglo-Argentine Tramways Co., Ltd.

The annual meeting was held on Friday last, at Winchester House, E.C., Mr. J. B. Concannon presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 596), said that last year they carried 299,154,385 passengers, an increase of 22,728,311 over the previous 12 months. The gross receipts amounted to £2,631,836, an increase of £212,650, or within a fraction of 9 per cent., a remarkable achievement when it was remembered that 1910 was the Centenary year, and that the weather conditions during the last three months of 1911 were very unfavourable. The working expenses were more by £159,835. Of this increase £10,000 was due to their having debited working expenses and carried to the credit of the renewals fund £120,000, as against £110,000 in 1910. Apart from the natural increase in expenses due to larger mileage and heavier traffics, some of the heads showed exceptional additions, thus, the cost of current, owing to dearer coal, was more by £22,563, and the extra 12 per cent. tax on surplus traffic receipts over $50,000 per km. of line open, added £21,389 to the municipal taxes; a further exceptional item amounting to £12,356, and one that would not recur, was caused by their having converted a deferred bonus payable to their employés into an increase of wages, thus, the figure he had mentioned, which represented the bonus payable for the last quarter of 1910, was charged to wages in 1911. It was interesting to note that but for these increases, which, in the aggregate, represented £56,000, the percentage of expenses to traffic receipts would have been 58·30, as against 59·10 in the preceding year. They expended £298,012 upon ordinary maintenance, and upon renewals £119,507, or a total of £417,519 applied to the all-important policy of preserving their property in the most efficient and up-to-date condition. The net profit amounted to £907,907, an increase of £52,815. The total amount at credit of net revenue account, including the carry over from 1910, was £920,952. After making provision for all charges and preference dividends, there remained a balance of £193,395, a very respectable margin of security for their pre-ordinary proprietors. An interim dividend of 4 per cent. had already been paid upon the ordinary shares, and a further dividend of 3¾ per cent. was now recommended, making 7¾ per cent. for the year, less income-tax, leaving a balance of £10,947 to be carried forward. At the request of his colleagues, he visited Buenos Ayres in September last, to represent the board at the inauguration ceremony to celebrate the commencement of active work on their first subway. The proceedings passed off most satisfactorily, and it was very pleasing to notice the friendly comments of the public and Press upon the project. He took the opportunity of visiting all the depôts and workshops; he made a close examination of the permanent way and rolling stock, and he found the undertaking as a whole in very good order. He was much impressed by Mr. Pedriali's organisation, and the able and loyal support he received from the officials working under him. With regard to the immediate future, whilst they could not expect that the receipts for the current year would show the same rate of progress as those of the two previous years, yet notwithstanding the increasing congestion which they were experiencing, and would continue to experience, pending the opening of the subways, he thought they might look for a moderate improvement of traffic. On the other hand, various economies which they hoped to carry out, particularly in the consumption of current, would neutralise the effect that dearer coal would have on the cost of current per unit.

Baron L. Janssen seconded the motion, and the report was adopted without discussion.

Mr. H. W. Birks, in moving the re-election of the auditors, said that on behalf of the shareholders he wished to congratulate the directors upon the splendid results they had put before them.

Mr. Prynne in seconding the motion, which was carried, asked what was the amount of interest paid on unproductive capital during the past year.

The Chairman, in reply, said that the amount of interest charged against unemployed capital last year was £17,643.

Swiss Electrical Companies.

The Aluminium Industrie, A.G., of Neuhausen, realised net profits in 1911, including the balance forward, amounting to £131,000, as against £138,000 in the previous year. It is intended to pay a dividend of 14 per cent., this having also been the rate in 1910.

The Motor Ges. fur Angewandte Elektrizitat, of Baden, which is closely associated with Brown, Boveri, & Co., proposes to pay 6½ per cent. for 1911 on a paid up share capital of £800,000, being the same rate as in 1910. The share capital is now being increased to £1,200,000 by the issue of new shares for the purpose of acquiring an interest in the Olten-Aarburg Electricity Works, and for providing additional working capital.

The Société Franco-Suisse pour l'Industrie Electrique, of Geneva, which is chiefly, if not entirely, an investment company, reports net profits of £47,000 for 1911, as compared with £43,000 in the preceding year. It is proposed to pay a dividend of 4½ per cent. on the share capital of £1,000,000, as against 4 per cent. in 1910. The stock of shares and other investments is valued at £1,670,000, and the advances made to electrical undertakings total £500,000, while on the other hand the company has a loan capital of £900,000.

The Akkumulatoren-Fabrik Oerlikon, which has a share capital of £48,000, reports net profits of £12,400 for 1911, as contrasted with £12,300 in the previous year. A dividend of 20 per cent. is in contemplation, being the same rate as in 1910. According to the directors' report, the scope for portable accumulators, particularly for traction purposes, has considerably increased. The sale for automobiles is specially capable of expansion, and the company has therefore become interested in a firm at Feldbach.

The report for 1911 of the *Elektrizitäts Gesellschaft Alioth*, of Basle, states that the exchange of shares which was arranged with Brown, Boveri & Co. was completed by most of the shareholders, and the community of interests thereby created would become closer in the current year. The sales organisations in Italy, Austria, Holland and South and Central America had been taken over by Brown, Boveri & Co., whilst that in Germany had been discontinued, and the offices at Basle had been amalgamated with those at Baden. In the spring of 1911 the company's branch at Lyons was transferred to the Compagnie Electro-Mécanique Le Bourget in return for a share interest in the latter. This French company took over in June the whole of the Alioth Co.'s sales organisation in France, and this explained for a large part the reduction in the profits. During the year the company, which was well employed in transmission and railway work, delivered 1,135 transformers of 60,820 kw. and 4,388 generators and motors of 94,480 h.p., as compared with 1,746 of 109,693 kw., and 6,153 of 116,276 h.p., respectively in the preceding year. The gross profits amounted to £65,000, as contrasted with £95,000 in 1910, and the net profits were £19,000, as against £28,000. After devoting £6,700 to depreciation, as compared with £11,000 in 1910, the balance allows of the payment of a dividend of 4½ per cent. on share capital of £240,000, as against 6 per cent. in the previous year.

Calcutta Tramways Co., Ltd.—The directors' report for 1911 gives the following figures: Receipts, £202,548; working expenses, £114,385; revenue balance, £88,163; plus balance brought forward, £1,662; making £89,825. Interest on debenture stock and bank advances, and dividend on preference and ordinary shares paid absorb £44,945, leaving £44,880. Out of this it is proposed to pay a final dividend of 4s. 6d. per share, making 7 per cent. for the year, adding to the depreciation fund £10,000 and carrying forward £3,918. The *Financial News* says that the depreciation fund at the commencement of the year stood at £59,603. After adding £1,622 interest on investments and £10,000 proposed to be allocated as above, and deducting £7,088 written off for renewals during the year, the fund will stand at £64,136. The traffic receipts show an increase of £15,470 and the expenditure an increase of £8,030; the Howrah lines show an increase in receipts of £316 and in expenditure, of £336.

Windermere and District Electricity Supply Co., Ltd.

The directors' report for the year ended December 31st, 1911, announces that Mr. A. H. E. Wood and Mr. George H. Pattinson have joined the board. The gross revenue shows an increase of £138, mainly due to larger receipts from the sale of current. The board's opinion, expressed a year ago, as to the falling off in receipts having come to an end was justified. Several new customers have been secured, and a moderate rate of improvement in the company's business may be looked for. A payment of 3¾ per cent. on account of arrears of interest has been received on the Keswick Electric Co.'s debentures, and from this source £71 has been credited to the net revenue account, and the amount owing by the Keswick Electric Co. for arrears of interest has been reduced by £283. The amount spent on capital account for new mains, transformers and meters has been £173. The expenditure on revenue account has been £1,912, being a decrease of £35, as compared with the previous year. The balance of revenue account is £1,617, plus interest on Keswick debentures £71, and balance brought forward £10, making £1,698. Out of this has been paid debenture interest, bankers' charges, &c., £786; interim dividend of 1 per cent. on preference shares, £250; leaving a balance of £663; out of which has been transferred to depreciation reserve account £400; leaving for disposal £263. The directors have doubled the amount transferred to depreciation reserve account as compared with the previous year, and they recommend that a further dividend of 1 per cent., making 2 per cent. for the year, be paid on the preference shares which will absorb £250 and leave £13 to be carried forward. A proposal to introduce Diesel oil plant into the works is receiving the serious consideration of the board, as it is shown that a large saving in working expenses would result. The debenture stock is due for repayment on December 31st, 1912, and the subject of its renewal has the attention of the directors.

German Electrical Companies.

The Elektrochemische Werke, of Bitterfeld, after writing off £4,900 for experimental work and £5,900 off investments, report net profits of £67,000 for 1911. A dividend at the rate of 10 per cent. is in contemplation on the ordinary capital of £275,000, being the same rate as in 1910. The company's chloride of potash works in Bitterfeld and Rheinfelden are leased to the Griesheim-Elektron Chemical Works, the former participating in one half of the profits.

The Ver. Isolatorenwerke, of Berlin-Pankow, report that a considerable increase took place in the volume of business in 1911, and the company was compelled to extend the manufacturing plant. It was, however, impossible to secure an improvement in prices, which were by no means satisfactory, and which still showed a falling tendency. After allocating £5,800 to depreciation, as compared with £2,700 in 1910, the accounts exhibit net profits of £6,200, as against £3,600 in 1910. It is intended to distribute 9 per cent., as contrasted with 4 per cent. in 1910. A good stock of orders was brought over into the new year, and the works are tolerably fully employed.

The accounts of the *Deutsche Kabelwerke*, of Berlin, indicate gross profits of £60,000 for 1911, as compared with £56,000 in the previous year. After providing for general expenses, taxes and interest charges, and setting aside £5,800 for depreciation as against £5,100 in 1910, there remain net profits of £24,000, as compared with £19,000. It is intended to pay a dividend of 7 per cent. on a share capital of £262,500 as against 8 per cent. on £175,000 in 1910. According to the directors' report, a further large increase in the turnover took place last year, but prices left much to be desired, whilst the new capital was not fully productive. The new financial year has been entered upon with an abundance of orders, and the volume of business already transacted is greater than in the corresponding period of 1911.

The Gesellschaft fur Elektrische Unternehmungen, of Berlin, which is purely an investment company concerned with undertakings situated in Germany and other countries, states in the report for 1911 that the working results of the lighting and tramway enterprises in question made further progress as compared with the previous year. The sale of securities yielded a profit of £82,000, and, with the interest and dividends received on other investments, the accounts show net profits of £271,000 for 1911, as against £245,000 in 1910. It is intended to pay a dividend of 10 per cent. on the share capital of £2,250,000, as compared with 9 per cent. in the preceding year. The share capital is now to be increased to £2,500,000, so as to provide funds for pending transactions and the extension of existing undertakings.

The directors of *Voigt & Haeffner, Akt. Ges.*, of Frankfort-on-Main, state in their report for 1911, that in order to be able to meet the large demand it was necessary to enlarge the new buildings which were only brought into use for the first time in the previous year. The considerable increase in the turnover was fairly distributed over various countries, but prices were just as unfavourably low as in years of declining trade. As gross profits the accounts show the sum of £100,000, as compared with £72,000 in 1910; after providing for general expenses and depreciation to the extent of £12,000, as against £6,200 in 1910, the net profits and balance forward are returned at £45,000, as compared with £30,000. A dividend at the rate of 10 per cent. has been declared on the increased capital of £250,000, as compared with 10 per cent. on £150,000 in each of the four preceding years. At the recent meeting it was mentioned that the orders on hand in the new financial year were 60 per cent. greater than a year ago. It is now proposed to issue debentures for £100,000 to provide additional working capital.

The Bergmann Elektrizitatswerke A.G., which has developed in recent years from a manufacturing undertaking for installation materials into one for the production of all classes of machinery and plant, is now confronted with the necessity of raising additional share capital of from £750,000 to £1,000,000 for the purpose of extinguishing the bank debt and providing additional working capital. Even the increase in the share capital to £1,450,000 and the emission in 1909 and 1911 of loans totalling £1,000,000 have been insufficient to cope with the large expansion which the undertaking has experienced, and the very high dividends paid in former years are now a matter of the past. The turnover in 1910 amounted to £2,500,000 and is said to have been advanced to £3,300,000 last year, but prices have not kept pace with the increased volume of business owing to the prevalence of severe competition. The dividends paid in 1910 was 12 per cent., but is estimated at from 6 to 7 per cent. for 1911. It is reported, although not for the first time, that a close connection may be formed with one of the larger companies.

German-Netherlands Telegraph Co.

The report for 1911 of the Deutsch-Niederlandische Telegraphen Gesellschaft, of Cologne, states that, notwithstanding the political revolution in China, the telegraph traffic with the Far East experienced an increase, and it is assumed that the traffic there will further develop. On the other hand, the augmentation in Netherlands-India, which was brought about by the development in the rubber market in 1910 was not maintained, although the traffic between that part and other countries had an upward tendency, on the whole. The company's cables were free from interruption during the year.

It is mentioned that negotiations are pending with the German Government in regard to a scheme for connecting the most important German colonies in the South Sea with the world's telegraph system, by the establishment of wireless stations at Yap, Nauru, Rebaul in New Guinea, and Apia in Samoa. The company has participated in the negotiations because the proposed stations would presumably act as feeders to its cable traffic, and because it is important for the company to gain experience as to the efficiency of this means of communication. The Government is thinking of granting a joint concession to the company and the Gesellschaft für Drahtlose Telegraphie, of Berlin, for the purpose of forming a new company to undertake the establishment and working of the stations in question. The capital of the new company is to be £105,000, of which £65,000 will be in shares and £40,000 in the form of 4½ per cent. debentures, of which each of the promoting companies would subscribe one-half. An increase in the capital of the German-Netherlands Co. will not be necessary, as the money can be gradually withdrawn from the liquid funds. In the event of the concession being granted under suitable conditions, and the Government sanctioning assistance, the company intends to take part in the constitution of the new company.

The accounts, including the balance forward, show net profits of £40,700 in 1911, as contrasted with £38,000 in the previous year. It is proposed to pay a dividend of 6½ per cent. on the share capital of £350,000, being the same rate as in 1910.

Oriental Telephone and Electric Co., Ltd.

The directors' report for 1911 states that, including £18,100 brought forward from 1910, and after deducting the interim dividends of 3 per cent., paid on November 1st last, on both the preference and ordinary shares, and making the necessary provision for redemption of the debenture stock of the company and other charges, as shown in the net revenue account, the amount to be dealt with is £48,681. The directors recommend a final dividend of 3 per cent. (less income-tax) for the year on the preference shares (£1,500), a final dividend of 5 per cent. (free of income-tax) on the ordinary shares issued, making 8 per cent. for the year, £8,966, transferring to reserve account £10,000, to reserve for contemplated staff pension scheme £1,000, and writing off expenditure on exchanges, &c., £3,500, leaving to carry forward £23,715. All the company's exchanges, as well as the whole of the subsidiary companies, show improvements in revenue during the past year. The Bombay Telephone Co., Ltd., has increased its dividend from 8 to 9 per cent., and the Bengal Telephone Co., Ltd., from 5 to 6 per cent. The Telephone Co. of Egypt, Ltd., and the China and Japan Telephone and Electric Co., Ltd., continue to pay their previous rates of 10 and 5 per cent. respectively. These dividends have been received in London, and are, as usual, included in the revenue account. Underground cabling extensions in Madras have now been completed, and similar work is in progress at Rangoon, from which it is expected additional revenue will accrue to the company. The extensions in the Island of Mauritius, referred to in the last report, are now nearly completed, and the sub-exchange at Curepipe will be working very shortly. After the conclusion of the ordinary business at the annual meeting on April 24th, extraordinary resolutions will be proposed regarding alterations in the memorandum and articles of association. These provide for the carrying on of a general import and export business within the Island of Mauritius, and other matters.

Electricity for Ship Propulsion. — The Electric Marine Propulsion Co. has been formed in Glasgow with a capital of £60,000, to acquire the interests of Messrs. Mavor & Coulson and Mr. Henry A. Mavor in inventions for the application of electricity to ship propulsion.

Babcock & Wilcox, Ltd.

In our last issue we briefly announced the dividend declaration of this company. The directors' report for the year ended December, 1911, has now been received, and states as follows:—

The net profit during the year amounted to £379,224, plus £68,643 brought forward, making a balance of £447,867. After deducting the interim dividends paid October, 1911, of 3 per cent. on the preference shares, and of 12 per cent. on the ordinary shares, amounting to £102,600, there remains a balance of £345,267, from which the directors recommend that the dividends as stated by us last week be paid, absorbing £135,800. Of the remaining £209,467, there is placed to the reserve fund £130,000, bringing this fund up to £830,000, £10,000 is placed to the staff pension fund, and £69,467 is to be carried forward. The volume of business done last year showed an increase over that of the previous year. The constantly increasing cost of labour requires continuous extension of the firm's organisation and the employment of its capital resources and reserves to compensate for the tendency of the rate of profit on orders to be reduced. . . . . Having regard to the fact that the extension of the business has required the reserve fund to be employed as working capital, the directors have under consideration a proposal that an amount equal to the existing ordinary capital of the company be taken from the reserve fund and added to the capital account. It is recommended to make the same provision for the staff pension fund as was made last year.

In a circular that accompanies the above report, the directors call an extraordinary general meeting for April 23rd to pass a resolution increasing the capital to £1,760,000 by the creation of 830,000 new ordinary shares of £1 each. The reason for this step is as follows:—

As has been stated at several annual meetings of the company, our trading has largely extended, and the profits have not only been earned by the use of the nominal capital of the company, but also by the use of the reserve fund and other assets, so that the rate of profit and dividend, although appearing high on the nominal capital, was much lower, taking the additional employment of the other assets into consideration. It is proposed to adjust this condition by adding the ordinary reserve fund to the capital account, thus increasing the latter to £1,760,000 (being £100,000 6 per cent. preference shares and £1,660,000 ordinary shares), and to issue to the ordinary shareholders in respect of the reserve fund one additional fully-paid £1 share for each such share now held. It follows that by this re-arrangement the portion of the profits appropriated to dividend would be distributed in future over the larger capital.

Arbroath Electric Light and Power Co., Ltd.—Mr. George Balfour presided at the annual meeting of this company. The report showed a net profit of £1,028 for the year plus £978 brought forward, making an available balance of £2,006. This the directors proposed to apply as follows, viz.:—To reserve fund, £500; in payment of dividend at 2½ per cent., £563; leaving to be carried forward, subject to directors' and auditors' fees, £943. The chairman stated that the time was opportune for increasing the share capital of the company in order to pay off the bank loan, and provide for the further development of the company's business. They had come to the conclusion that it would be preferable to adopt this course rather than issue debentures, as originally intended, and accordingly it was proposed to increase the capital from £30,000 to £40,000, and to divide the same into 25,000 ordinary shares and 15,000 cumulative preference shares of £1 each. The preference shares, of which only 10,000 would be issued until further capital expenditure was necessary, would carry a cumulative preferential dividend of 5 per cent., increasing to 6 per cent. whenever the ordinary shares receive a like dividend, and it was considered that the preference shares would form an attractive investment, looking to the dividend-paying stage now reached by the company. The report was unanimously adopted.

Prospectuses.—*Newcastle and District Electric Lighting Co., Ltd.*—The list of applications was to close on Wednesday, 17th inst., in an issue of £150,000 6 per cent. second mortgage debentures at 99½ per cent. in denominations of £100 and £20.

The Scottish Tube Co., Ltd.—The list was also to close on Wednesday in an issue of £200,000 5 per cent. convertible mortgage debenture stock in this company, at par. The company has been formed to amalgamate a number of Scottish tube companies. The capital being issued is £506,955 (300,000 cumulative preference and 206,955 ordinary), which, except the shares allotted for cash to the subscribers of the memorandum of association, are to be allotted partly as fully-paid to the vendors in part payment of the purchase price, and partly to Messrs. Stewarts & Lloyd's, Ltd., for cash. It is stated in the prospectus that the tube trade has been generally prosperous for many years, but for the past two years severe internal competition has reduced profits. It is expected that the amalgamation will consolidate interests, reduce oncost and management charges, combine the practical knowledge of the directors and place the trade of the company on a sound and satisfactory footing. The price payable to the vendors for the various businesses, &c., is £646,255.

Telephone Co. of Egypt, Ltd.—The directors have declared a dividend of 6 per cent., free of income-tax, on the preferred and deferred shares for the half-year to December 31st, making 10 per cent. for the year. £1,000 is placed to reserve for staff pension fund and £85,955 is carried forward.

Continental.—France.—La Société d'Energie Electrique du Nord de la France is increasing its capital from £280,000 to £400,000. The report for the last financial year shows a profit of £28,686.

Belgium.—La Société Belge pour la Fabrication des Cables et Fils Electriques, of Brussels, is increasing its capital to £40,000.

Italian Electricity Companies.

The financial results realised by the Italian subsidiaries of German and Swiss manufacturing or banking interests, which are of a fairly numerous character, are now in course of publication for the year 1911. Among those associated with the Schuckert group, a Milan correspondent states that the Società Sicula Imprese Electriche, of Palermo, proposes to pay a dividend of 6 per cent., as compared with 5 per cent. in 1910, whilst the Società Industriale Elettro-Chimica di Pont St. Martin, which was unable to make any distribution in 1910 owing to damage caused to its hydro-electric works, intends to pay 4s. per share for the past year. The Società Toscana Imprese Elettriche, of Florence, contemplates the payment of 10 per cent. for 1911, being the same rate as in the preceding year. On the other hand, the Società Bergamasca Distribuzione Energia Elettrica is compelled to reduce the rate to 5 per cent., as contrasted with 6½ per cent. in 1910, in consequence of the decline in sales due to the crisis in the cotton industry. The electricity undertakings connected with the A.E.G. group and the Swiss Bank for Electrical Enterprises include the Officine Elettriche Genovesi, which supplies light and power for industrial purposes and power for the tramways in Genoa, and which intends to pay 10 per cent. for 1911, as was also the case in the previous year. The Unione Italiana Tramways Elettrici, which was able to increase the rate from 8 per cent. in 1909 to 8½ per cent. in 1910, is to raise the rate to 9 per cent. for the past year, whilst the Idroelettrica Ligure proposes to distribute 6 per cent., as against 5 per cent. in 1910. The Società Elettrica Riviera di Ponente, which is associated with the Swiss Electrical Industry Co., of Basle, intends to raise the share capital from £480,000 to £600,000, and to issue bonds of £240,000 for the construction of a power station on the Upper Roja.

Midland Electric Corporation for Power Distribution, Ltd.—The directors report (says the *Financier*) that the accounts for the year to December 31st show a balance at credit of net revenue account of £2,500. Under the agreement referred to in the report accompanying the accounts for 1909, the debit balance in revenue account of £4,239, shown in the balance-sheet of last year, has been discharged; the agreement terminated on December 31st last.

STOCKS AND SHARES.

Tuesday Evening.

Business in the Stock Exchange is waking up with a vengeance. Most of the markets, apart from those concerned with mining shares, are actively employed. Prices are good; there is a large volume of investment and a still bigger amount of speculation. The latter, in fact, has assumed such proportions that some of the cooler heads in the Stock Exchange deprecate it, and are already talking about a day of reckoning for the bulls when the latter shall least expect it. The various departments connected with electricity are sharing in the trade which is going on, and the difficulty of an Autolycus who writes notes on the different sections is not to find things to discuss, but to compress within reasonable limits the many factors of importance and interest which ought to be touched upon in such a column as this.

Home Railway stocks are in high favour. With the end of the coal strike has come a wild outburst of strength, in which Undergrounds and Kentish issues stand out with the greatest prominence. The Southern stocks are buoyed up by hopes of coal being discovered at last in Kent, and indiscriminate bullishness does not stop to consider what quality it may be, or anything so mundane as this. Amongst the Undergrounds, the feature of the week is a continuance of the rises in Metropolitans, Districts, and Underground Electric shares. On top of their rise of 2½ last week, Metropolitans have improved to the extent of 2¾; while Districts, in addition to their previous rise of 4 points, have put on a further 1½, bringing the price up to 48¾. Underground Electric shares rose no less than £1 at one time to 4½⅛, receding later to 4⅛, at which the price still shows a gain of 12s. 6d.: while the 6 per cent. income bonds at 92 are 3 up. Central Londons have recovered part of their reaction, the Ordinary and Deferred both standing at 85, being higher this week. City and South London, on the other hand, eased off to 42¼. Great Northern and City Preferred are 5s. down, but East London issues enjoyed big rises. The business being done in all of these is on a huge scale, and there can be no doubt that a good part of it is of the highly speculative order. London United Tramways Preference have risen ½, and British Electric Traction are a better market; there are two or three small rises in some of the issues. Metropolitan Electric Tramways Ordinary and Potteries Ordinary are both marked *ex* dividend, the deductions having little effect.

Another sensational rise in City of London Ordinary and Preference has been accompanied by reports to the effect that the City Corporation has signed an agreement by which the company's Ordinary shares will be taken over on the basis of £27 per share. All things are possible, of course, especially to the City of London Corporation; but it is difficult to see what justification there can be for this, and only the personal feeling which is known to exist between the Corporation and the London County Council gives colour to the report. Until further details are available, it appears superfluous to discuss the matter further. Metropolitans are ½

higher, and Charing Cross rose to the same extent. County of London put on a similar fraction, and if any of the shares on the list are cheap it would seem to be these. The new shares are still quoted at ¼-⅜ premium for special settlement. Other Lighting shares are steady. Holders may be advised to keep their shares, for there are active negotiations going on in at least two directions which may have a marked effect upon quotations if they materialise. In the provincial list, several of the principal shares are in demand, without dislodging a supply, and it may be said that the market as a whole is very hard.

Marconis have had a further jump, which can only be described as phenomenal, and the prophets who talked them to £10 a share are beginning to vaunt their prescience, for which, it must be frankly admitted, they have every reason. The parent shares show a rise of no less than 35s. on the week, and there have been substantial recoveries in Canadian Marconis and in Spanish, after both shares had experienced sharp falls as the weaker bulls were shaken out. The advent of a new company to deal with the American patents is daily expected, and the market is agog with excitement and curiosity to see at what price the new shares will be placed. The next item of interest in this department is a rise of 10 in National Telephone Deferred, bringing the price to 148. Reference was made here last week to the vague optimism with regard to the price at which the stock will be paid off by the Government. Dealing in National Telephones, however, is so risky as to be practically *caviare* to the ordinary investor, who is content, and rightly so, to leave the gamble to a small circle of speculators. The company's Third Preference shares have risen ⅜ to 5¼ middle.

West India and Panama shares are still a dullish market, although there was a recovery from the worst. Nothing of special interest has transpired to give the market a fillip, and there is still some fear as to what damage may have been done by the recent seismic disturbances reported from the Isthmus. The Eastern group is decidedly firm. Eastern Ordinary is 3 points better, and Eastern Extension shares are 10s. higher, following up their improvements of last week; while Globe Preference rose ½ to 13¼ in sympathy with the advance in Easterns. Great Northern Telegraphs are slightly easier, but Western Telegraphs are ⅛ up. The strength of the American Railway market led to a rise of 2 in Mackay Companies' common shares, and American Telephone Capital stock is a point better. A sharp rise occurred in Anglo-American Deferred, in which fresh speculative interest has just been kindled. The stock has been neglected for some time, and is now having a turn of strength.

United River Plate Telephones are better, and several other improvements have occurred amongst the purely investment issues. Indeed, the market, as a whole, displays considerable strength, with the investor on the search for sound securities which have not risen much up to the present.

In the Manufacturing group, Edison & Swan fell $\frac{3}{16}$ to ⅛, and the 4 per cent. Debenture stock lost a point, the former being pressed for sale. Callenders have gone ahead, and the price is up to 11, which is substantially better than it was a fortnight ago. On the other hand, India Rubber shares have gone back to their par price of 10. British Westinghouse 4 per cent. Debenture stock has again improved a little. The excellent report just published by the Babcock & Wilcox Company has had no further influence upon the price of the shares, which keeps at 6¾ middle, this, of course, including the recently-declared dividend.

In the Foreign Traction division business is very active. The principal rise is one of 6½ in Sao Paulo Tramway shares, the quotation jumping to 210. Mexico Trams, allowing for the dividend, are 3¾ higher; while Rio Trams, also *ex* dividend, are up 3 points. Para Electric Ordinary rose 10s., and a number of similar rises have been secured by the popular issues, the appetite for which appears to be insatiable. Mexican shares and bonds are again in request, in spite of the contradictory news which is still received from the theatre of what is politely called the revolution. The impression gains ground that the United States have a larger hand in the movement than was at first supposed; and if the course of events runs in such a fashion as to give Uncle Sam a preponderating hand in Mexico, there can be no doubt that this would make for the ultimate prosperity of all the companies concerned, although, as we have pointed out before, its consummation may lead to further outbreaks in the meantime. A number of traction, light and power companies operating in the various parts of the United States are enjoying a run of speculative attention. As an instance, the Alabama Traction, Light and Power Company may be mentioned, the shares in which not long ago stood at 28 and are now 43½, while those in the Georgia Company have been run up from 30 to about 41. Without a doubt, there is enormous scope for such concerns, but when it is remembered that, in many cases, the shares are nothing more nor less than "water," it wants robust faith to buy them, except as highly speculative counters, at anything like current prices. One thing which is being largely tipped is the common issue of the Mexico Northern Power Company, the shares being about 28; but here again, it is just blind faith that will buy such shares.

The new issue of Newcastle and District Electric Lighting Debenture has been made this week, and of the success attending it there are no details available up to the time of writing. An example of the manner in which some new issues are introduced is afforded by the offer of 1½ million dollars Empire District Electric Company 5 per cent. first Mortgage bonds. This will be made publicly some time hence; but, in the meantime, the bonds are being placed on terms by which the applicant takes them firm and receives 2½ per cent. back again when the prospectus comes out. There was an eager demand for the privilege of advance subscription, which is different from underwriting inasmuch as the subscriber takes the bonds firm and guarantees to pay up the instalments as they become due.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	Inc.
		£	£*		£	£*		
Aberdeen	April 10	2,624	+ 63	45	65,875	+ 3,467	14·4	..
Ayr	„ 13	480	+ 50	48	18,973	+ 2:4	8	..
Bath	„ 13	1,810	+ 447	15	10,604	+ 883	14·75	..
Birkenhead	„ 14	2,107	+ 24	2	2,108	— 290	13·68	..
†Birmingham Corp.	Mar. 31	11,849	+5,755	52	473,9·7	+113,906	56·4	..
Blackburn	April 10	2,482	+ 431	2½	2,678	+ 427	14·62	..
†Blackpool Corp.	„ 11	1,806	+1,211	..	2,325	+ 1,513	11·87	..
Blackpool-Fleetw'd	„ 13	1,0·1	+ 98	14	4,771	+ 553	8	..
Bournemouth	„ 10	3,889	+1,374	1½	3,059	+ 994	21·35	..
Bradford	„ 6	9,756	+ 614	1	4,761	— 1,267	56	1·2
Brighton	„ 14	2,073	+ 290	2	2,073	+ 73	9·5	..
Bristol	„ 12	14,514	+3,225	..	92,695	+10,785	30·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 5	599	+ 191	14	3,809	+ 972	3·65	..
Barnsley	„ 6	201	— 149	„	2,193	— 154	..	..
Barrow	„ 5	740	+ 258	„	4,362	+ 1,189	5·37	..
Devonport	„ 5	1,148	+ 286	„	6,905	+ 1,187	8·85	..
Gateshead	„ 6	1,964	— 18	„	13,710	+ 1:9	11·25	..
Gravesend	„ 5	305	+ 46	„	2,692	+ 272	6·5	..
Greenock	„ 5	1,539	+ 212	„	9,833	+ 1,510	7·25	..
Hartlepool	„ 5	506	+ 76	„	3,215	+ 318	6·72	..
Kidderminster	„ 5	190	+ 22	„	1,242	+ 112	..	..
†Leamington	„ 5	292	+ 6	„	1,963	+ 114	..	..
Merthyr	„ 5	306	— 73	„	2,478	— 40	2·9	..
Metropolitan	„ 5	17,875	+2,463	„	118,989	+ 9,913	22	..
Middleton	„ 5	618	+ 46	„	3,875	+ 35	8·6	..
Mid. Joint Com'tee	„ 5	6,064	+ 426	„	40,·04	+ 1,684	..	..
Oldham—Ashton	„ 5	1,239	+ 177	„	7,641	+ 557	9·13	..
Peterborough	„ 5	245	+ 42	„	1,572	+ 211	5·31	..
Potteries	„ 5	2,742	—1,120	„	24,275	— 1,504	29	..
Rothesay	„ 5	124	+ 6	„	713	+ 84	2·75	..
Southport	„ 5	516	+ 45	„	13,287	+ 120	8·17	..
S. Metropolitan	„ 5	1,755	+ 486	„	10,006	+ 771	..	..
Swansea	„ 5	2,056	+ 6	„	14,811	+ 620	12·5	..
Tynemouth	„ 5	362	+ 69	„	2,029	— 30	3·75	..
Weston-s-Mare	„ 5	61	+ 8	„	358	+ 96	3	..
‡Worcester	„ 5	5·6	+ 69	„	3,385	+ 142	5·75	..
Wrexham	„ 6	216	+ 18	„	1,313	+ 99	..	..
Yorks. Wool. Dist.	„ 5	1,·29	+ 9	„	13,874	+ 455	17	..
Miscellaneous	„ 5	432	+ 41	„	2,803	+ 191	..	..
Burnley	„ 13	3,228	+ 262	..	..	..	11·73	..
Burton-on-Trent	„ 14	551	+ 44	2	551	+ 43	6·6	..
Bury	„ 14	2,912	+ 179	2	2,912	— 234	22·5	..
†Cardiff	Mar. 30	1,923	— 176	52	125,479	+ 8,672	17·35	..
Chatham and Dist.	April 11	2,661	+ 265	15	11,590	+ 687	14·18	..
Cork	„ 11	968	+ 37	15	6,428	+ 78	9·89	..
Croydon	„ 5	3,101	+ 389	⅜	1,335	— 127	11·6	·75
Darlington	„ 6	404	+ 16	1	204	+ 17	4·87	..
Darwen	„ 5	486	+ 14	1	242	+ 9	4·86	..
Dover	„ 6	440	+ 102	1	243	+ 17	4·76	..
Dublin	„ 12	12,183	+1,960	..	79,599	+ 6,722	54·25	..
East Ham	„ 13	2,318	+ 214	2	2,102	+ 311	7·87	..
Exeter	„ 12	604	+ 63	2	575	+ 15	5·5	..
Glasgow	„ 13	37,244	+ 219	..	855,996	+44,466	98	·75
Hastings	„ 11	2,6·2	+ 518	..	..	+ 789	19·3	..
Huddersfield	„ 13	3,880	+ 147	2	3,883	+ 150	20·5	1
Hull	„ 13	5,894	+ 295	2	5,689	— 585	13	1·5
Ilkeston	..	..	..	..	..	..	..	..
Ipswich	„ 13	914	+ 143	2	916	+ 275	10·5	..
Kilmarnock	„ 6	2·6	+ 4	47	7,536	+ 471	4·25	..
Lancashire United	„ 15	2,816	+ 399	15	17,720	+ 866	89	..
Leeds	„ 13	13 046	+ 793	2	14,447	+ 1,591	57·5	..
Leicester	„ 13	4,206	— 299	..	..	..	20	..
Leith	„ 6	1,385	+ 204	46⅜	80,291	+ 9,747	5·724	..
Liverpool	„ 6	23,858	+1,567	139	160,205	+ 9,506	116	..
†L.C.C.	„ 3	86,691	+4,268	..	2,510,908	+117,578	139·5	3
London United	„ 6	12,622	+2,021	..	76,259	+ 8,095	..	..
Lowestoft	„ 13	327	+ 80	28	4,397	+ 45	9·5	..
Manchester	„ 13	33,881	+2,579	2	32,606	+ 4,305	105	..
Newcastle	„ 13	8,675	+ 259	..	8,350	— 617	31·3	..
†Newport	Mar. 30	570	— 87	52	36,467	+ 954	7·25	..
Oldham	April 7	3,989	+ 264	2	3,989	— 264	29	..
Pontypridd	„ 13	610	— 210	2	610	— 210	5·5	..
Portsmouth	„ 6	4,014	+ 674	1	2,248	+ 664	15·25	..
Preston	„ 10	1,·65	+ 218	2	1,565	+ 218	10	..
Rotherham	„ 11	1,229	— 20	1½	1,106	+ 211	12	..
Salford	„ 8	10,035	+1,158	1½	6,017	+ 6 0	41	..
Sheffield	„ 16	11,479	— 512	3	17,198	— 26	40	..
Southampton	„ 10	1,·35	+ 407	1⅔	1,885	+ 427	11	..
Southend-on-Sea	„ 10	1,688	+ 801	2	1,265	+ 598	7	..
South Shields	„ 13	1,073	— 108	2	1,074	+ 28	10·25	..
Swindon	..	..	..	..	..	..	..	..
Tyneside	„ 10	1,225	+ 424	15	6,483	+ 820	11	..
Wallasey	„ 13	2,245	+ 260	1⅔	2,146	— 31	8·72	..
Walthamstow	„ 6	1,432	+ 594	..	..	..	9	..
West Ham	„ 4	5 146	+ 400	1	2,559	+ 198	15·25	..
Wolverhampton	„ 10	2,061	+ 837	..	..	..	13·75	..
Cen. London Rly	„ 13	7,422	— 2,500	15	72,158	— 7,814	6·32	..
City & S. Lon. Rly.	„ 14	5 642	—1,025	15	48,953	— 2,724	7·26	..
Dublin-Lucan Rly.	„ 12	319	+ 74	15	1,730	+ 119	7	..
G.N. and City Rly.	„ 13	3,116	+ 148	15	25,197	+ 1,488	3·5	..
L'pool Overh'd Rly.	„ 14	3,015	+ 174	15	22,157	+ 1,413	6·6	..
Llandudno-Col. Bay	„ 12	583	+ 194	19½	2,892	+ 419	6·5	..
Lond. Elec. Ry. Co.	„ 13	25,875	— 980	15	217,280	+ 5,680	21·25	..
Mersey Railway	„ 13	4,155	— 106	15	30,772	— 97	4·5	..
Metropolitan Rly.	„ 14	30,416	—3,246	15	248,821	— 6,949	35·75	..
Met. District Rly.	„ 13	22,472	+ 535	15	187,915	+ 8,085	25	..
Anglo-Argentine	„ 8	102,383	+1,998	15	719,718	+23,12·	..	..
§Auckland	Mar.	17,468	+1,409	..	154,·72	+12,457	23·8	..
Bombay (B.E.T.)	April 8	6,186	+ 221	11	82,899	+ 2,227	..	..
§Brisbane	Feb.	6,700	—1,575	8	23,734	—1·,101	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	April 13	7,886	+ 607	..	..	+ 7,220	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Mar.	3,884	..	3	8,·62	..	20·5	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	Mar. 31	1,888	+ 458	..	9 508	+ 647	..	..
§Montevideo	Mar.	31 498	+3,·71	5	157,227	+16,·07	..	..
†Perth (W.A.)	April 12	3 916	+ 6·9	15	28,476	+ 4,861	29	..

* Compared with the corresponding period of 1911. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations April 16th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord. ..	10	5½	5½	8¼ — 9¼	..	5 19 0
Do. 4½ % Pref.	10	4½	4½	8¼ — 9¼	..	4 14 9
Do. Second 6 % Pref. ..	10	6	6	10½ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	100 —102	..	4 8 3
Brompton & Kensington, Ord...	5	10	10†	8¼ — 8⅝	..	5 14 3
Do. 7 % Cum. Pref.	5	7	7	7⅞ — 8¼	..	4 6 2
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 2
Charing Cross, West End & City	5	5	5	4½ — 5	+ ⅛	5 0 0
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4½	..	5 0 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8⅞ — 4⅞	..	5 2 10
Do. Do. 4 % Deb... ..	100	4	4	95 — 98	..	4 1 8
Chelsea, Ord.	5	5	5	4¾ — 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	7	8	21 — 23	+3½	3 9 7
Do. 6 % Cum. Pref.	10	6	6	19 — 21	+⅝	2 14 4
Do. 5 % Deb.	Stock	5	5	117 —121	..	4 2 8
Do. 4½ % Second Deb. ..	100	4½	4½	101 —104	..	4 6 7
County of Durham, 5 % First Mort. Deb.	Stock	5	5	87 — 89	..	5 12 4
County of London, Ord... ..	10	5	6	10½ — 10⅞	+ ⅛	5 10 4
Do. 6 % Pref.	10	6	6	11⅛ — 11⅝	..	5 3 0
Do. 4½ % Deb.	Stock	4½	4½	107 —109	..	4 2 7
Do. 4½ % Second Deb. ..	Stock	4½	4½	101 —104	..	4 6 7
Edmundson's, Ord.	5	Nil	Nil	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	3 — 3½	+ ⅛	Nil
Do. 4½ % First Mort. Deb. ..	100	4½	4½	86 — 89	..	5 1 2
Folkestone	5	6	6	4¾ — 4¾ xd	..	6 3 1
Do. 5 % Cum. Pref.	5	5	5	4½ — 4⅝ xd	..	5 5 3
Do. 4½ % First Deb.	100	4½	4½	93 — 96	..	4 18 9
Hove	5	9	9	6½ — 7 xd	..	6 8 7
Kensington & Knightsbridge, Ord	5	9	9	7⅛ — 7⅜	— ⅛	5 16 2
Do. 4 % Deb.	Stock	4	4	92 — 95	..	4 4 3
Kent Elec. Power, 4½ % Deb. ..	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	8	2	2⅜	1⅝ — 2⅛	..	3 11 2
Do. 6 % Pref.	5	6	6	4⅞ — 5⅛	..	5 14 3
Do. 4 % First Mort. Deb. ..	Stock	4	4	91 — 94	..	4 5 1
Metropolitan	5	5	4†	3⅜ — 4⅛	+ ⅛	5 17 8
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 17 4
Do. 4½ % First Mort. Deb. ..	Stock	4½	4½	101 —104	..	4 6 7
Do. 3¼ % Mort. Deb.	Stock	3¼	3¼	84 — 87	..	4 0 6
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96 — 98	..	4 11 10
Newcastle-on-Tyne	5	4	4†	3⅝ — 3⅞	..	5 8 8
Do. 5 % Pref., Non-Cum. ..	5	5	5	4¼ — 4⅝	..	5 14 3
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 13 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	10 — 11	..	5 9 1
Oxford	5	7½	7½	5⅞ — 6⅛	..	5 13 9
St. James' and Pall Mall, Ord.	5	10	10	8¼ — 9	..	5 11 1
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord. ..	5	Nil	2	1⅜ — 1⅞	..	..
South London, Ord.	4	5	5	2⅜ — 3¼	..	6 8 0
Do. 5 % First Mort. Deb. ..	100	5	5	99 —102	..	4 18 0
South Metropolitan, 7 % Pref...	1	7	7	1⅛ — 1⅜	..	6 1 0
Do. 4½ % First Deb. Stock ..	100	4½	4½	96 — 99	+1	4 11 0
Urban, Ord...	5	5	..	2⅛ — 2⅜	..	..
Do. 5 % Cum. Pref.	5	5	..	2⅝ — 3⅛	..	..
Do. 4½ % First Mort. Deb. ..	100	4½	4½	85½ — 87½	+ ½	5 2 10
Westminster, Ord.	5	10	10	8¾ — 9⅛	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅛	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅜ — 5⅞	..	5 2 2
Calcutta, Ord.	5	8½	7†	6⅝ — 7¼	..	5 17 8
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 8
Calgary Power, 1st Mort. Bds.	100	5	5	92½ — 94½	..	5 5 8
Canadian Gen. El. Com. ..	$100	7	7†	116 —120	..	5 16 8
Do. 7 % Pref.	$100	7	7	116 —120	..	5 16 8
Cordoba Lt., Power and T., Ord.	1	3	3†	⅞ — 1	— 1/32	3 0 0
Do. 5 % Deb.	100	5	..	93 — 98	..	5 2 0
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	93 — 95	..	6 6 4
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	83 — 86	..	5 16 8
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	91 — 93	..	5 7 6
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	7/32 — 9/32	..	Nil
Do. 6 % Pref.	1	6	6	⅞ — 1	..	8 0 0
Kaministiquia Power, 5 % G. Bs.	$500	5	5	110 —112	..	4 9 3
Madras, Ord.	5	..	..	2½ — 3	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 8
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	84 — 86	..	5 16 3
Mexican Lt. & Power, Common	$100	4	4	84 — 86 xd	+2	4 13 0
Do. 7 % Cum. Pref.	$100	7	7	105 —107	..	6 10 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	94½ — 96½	+ ½	5 3 8
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	88 — 90	+ ½	5 11 1
Montreal, Lt., H. and Power ..	$100	7	8	208 —213	..	3 15 2
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	..	12 3 10
River Plate, Ord.	Stock	10	..	259 —262	..	3 16 4
Do. 6 % Non-Cum. Pref. ..	Do.	6	6	110 —115	..	5 4 4
Do. 5 % Deb. Stock	Do.	5	5	103½—104½	..	4 15 8
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	99 —101	..	4 9 1
Shawinigan Water, Capital ..	$100	4	5†	139 —143 xd	..	3 9 11
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	108 —110	..	4 11 0
Do. 4½ % Per. Deb.	Stock	4½	4½	103½—105½	..	4 5 4
Toronto Power, 4½ % Deb. ..	Do.	4½	4½	99½—101½	..	4 8 8
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	99½ — 94½	..	5 5 10
Victoria Falls Power, Pref. ..	1	Nil	11¾d.	⅞ — 1 1/32	+ 3/32	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	104½—106½	..	5 12 8

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7⅛ — 7⅝	..	..
Do. 5 % Deb. Red.	Stock	5	5	97½ — 99½	..	5 0 6
American Telep. & Teleg., Cap.	$100	8	8†	149 —151	+1	5 6 0
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph ..	Stock	3½	3	65 — 67 xd	..	4 9 7
Do. 6 % Pref.	Do.	6	6	108 —109 xd	..	5 10 1
Do. Def.	Do.	80/-	80/-	25⅜ — 26½	+ ⅛	5 14 3
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	100¾—102½	..	4 17 7
Chili Telephone	5	7	..	7⅛ — 7⅜	+ ⅛	4 13 4
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	84¼ — 86½	—1	4 12 6
Cuba Telegraph	10	6	6†	9⅞ — 10⅛	..	5 11 7
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4·	4†	3¼ — 3⅜	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	7⅞ — 8⅛	..	6 1 8
Do. 4½ % Debs.	50	4½	4½	99 —101	..	4 9 1
Direct United States Cable ..	10	4½	..	7⅜ — 8⅛	..	5 9 0
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	5†	134 —137	+2½	5 2 2
Do. 3½ % Pref. Stock.. ..	Do.	3½	3½	82 — 84	+1	4 3 4
Do. 4 % Mort. Deb.	Do.	4	4	101½—102½	+ ½	3 17 4
Eastern Extension	10	7	5†	13 — 13½	+ ½	5 3 8
Do. 4 % Deb.	Stock	4	4	99½—101½	..	3 18 10
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	95	4	4	99 —101	..	3 19 8
Globe Telegraph and Trust ..	10	5⅞	6†	10⅝ — 11	..	5 9 1
Do. 6 % Pref.	10	6	6	13 — 13½	+ ⅛	4 9 0
Great Northern Telegraph ..	10	18	18†	32 — 36	— ½	5 9 1
Indo-European Telegraph ..	95	18	5†	57 — 59	+ ½	5 10 2
Mackay Companies Common ..	$100	5	5†	33 — 35	+1½	5 17 8
Do. 4 % Cum. Pref.	$100	4	4	70 — 73	..	5 9 7
Marconi's Wireless Telegraph	1	5	..	9½ — 9⅝	+1/32	..
Do. 7 % Cum. Partic. Pref.	1	16	..	8⅝ — 8¾	+1/32	..
Monte Video Telephone, Ord. ..	1	6	6	1 — 1⅛	..	5 6 3
Do. 5 % Pref.	1	5	5	⅞ — 1	..	5 10 6
National Telephone, Pref. ..	Stock	6	6†	90½—102½	..	5 17 1
Do. Def.	Do.	6	6†	147 —149	+10	4 0 6
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅜ — 6	+ ⅛	4 3 4
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102½—103½	..	4 7 0
Oriental Telep. and Elec. ..	1	8	..	1⅛ — 1⅜	..	4 11 5
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1⅜	..	4 16 10
Do. 4 % Red. Deb.	Stock	4	4	83 — 90	+ ½	4 9 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99½—101½	..	3 18 10
Reuter's	8	5	5†	11⅜ — 12	..	3 6 8
Submarine Cables Trust ..	Cert.	6	6	127 —130 xd	..	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7⅜ — 7⅞	+ ⅛	5 1 7
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 8 11
West Coast of America	2½	2½	2½	1⅝ — 1⅞	..	3 11 8
Do. 4 % Debs., 1 to 1,800 guar. by Bras. Sub. Tel.	100	4	4	97½ — 99½	..	4 0 5
West India and Panama Teleg.	10	1½	1½†	4⅞ — 4 7/8	— 1/32	..
Do. 6 % Cum. 1st Pref. ..	10	6	6	10⅜ — 11½	..	5 8 0
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9⅜ — 10½	..	5 17 1
Do. 5 % Debs.	100	5	5	103½—104½	..	4 15 8
Western Telegraph, Ltd. ..	10	7	6†	13⅜ — 13⅝	+ ⅛	5 2 9
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
Western Union Tel., 4 % Bnds. A	$1000	4	4	106 —109 xd	+2	3 13 5
Do. 4½ % Fdg. Bonds.. ..	$1000	4½	4½	101 —104 xd	+1	4 6 7

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations April 16th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅞ — 1	..	Nil
Do. 5 % Pref.	1	5	5	6 — ⅜	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	78 — 83	..	5 8 5
Brit. Elec. Trac., 6 % Pref.	100	..	..	12 — 14	+ ½	..
Do. Do. Deferred	100	..	..	8 — 10	..	..
Do. Do. 6 % Cum. Pr'f.	100	..	..	91 — 93	+ ½	..
Do. 7 % Non-Cum. Pr'f.	100	..	..	37 — 40	+1	..
Do. 5 % Perp. Deb.	100	5	5	93½ — 96½	..	5 3 8
Do. 4½ % 2nd Deb.	100	4½	4½	80 — 84	..	5 7 2
Central London Railway, Ord.	100	3	3	84 — 86	+1	3 9 9
Do. Pref.	100	4	4	87 — 89	..	4 10 0
Do. Def.	100	2	2	84 — 86	+1	2 6 6
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
City & South London, Ord.	100	1½	1½	42 — 43	−1½	3 15 9
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	103 —105	..	4 15 3
Do. Do. 1901	100	5	5	102 —104	..	4 16 2
Do. Do. 1908	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
Dublin United Trams, 6 % Pref.	10	6	6	10⅜ — 11⅜	..	5 2 2
Great Northern & City, Pr'f. Ord	10	Nil	..	2⅛ — 2⅜	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	3†	¼ — ½	..	..
Do. 4½ % Deb.	100	4½	4½	71 — 76	..	5 18 5
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅜ — 2⅝	..	4 6 11
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	83 — 85	+1	5 17 8
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99	..	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	8⅜ — 8⅝	+ ⅛	..
Do. 4 % Deb.	100	4	4	78 — 78	..	5 2 7

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations April 16th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Metropolitan Railway Consol.	100	1⅞	1⅞	62½ — 69	+2⅜	2 14 4
Do. Surplus Lands	100	2⅜	2⅜	68 — 70	..	4 8 4
Do. 3½ % Deb.	100	3½	3½	89 — 91	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	86 — 88	+1	3 19 7
Do. 3½ % Con. Pref.	100	3½	3½	85 — 87	+1	4 0 6
Metropolitan District Ord.	100	Nil	..	48½ — 49	+1½	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3½	4½	89 — 91	..	4 18 11
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 2 3
Metropolitan Elec. Trams, Ord.	1	5½	6	12— 1 xd	..	6 0 0
Do. Def.	1	Nil	..	⅞ — 1	..	Nil
Do. 5 % Pref.	1	5	5	3⅜ — 3⅝	..	5 10 6
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	97 — 99	..	5 0 0
Potteries, Ord.	1	2	..	⅜ — ½ xd	..	..
Do. 5 % Pref.	1	5	5	1⅝ — 2	..	6 19 3
Do. 4½ % Deb.	100	4½	4½	89 — 92	..	4 17 10
South Metro. Trams, 6 % Pref.	1	6	..	⅜ — ⅞	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 4 0
Underground Elec. Railways	10	..	..	4½ — 4¾	+ ⅛	..
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1	1½†	91 — 93	+3	..
Yorkshire (West Riding), Ord.	5	Nil	..	⅜ — ⅝	..	Nil
Do. 6 % Pref.	5	Nil	..	2⅜ — 2¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 84	..	5 7 2

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½	5⅛ — 5⅜	..	5 2 4
Do. 2nd Pref.	5	5	5½	4⅞ — 5⅛	..	5 7 4
Do. 4 % Deb.	100	4	4	93½ — 95	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	102 —104	..	4 6 7
Do. 5 % Deb.	100	5	5	103 —105	..	4 15 3
Auckland Trams, 5 % Deb.	100	5	5	104 —106	..	4 14 4
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11⅛	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brisbane Trams Invt., Ord.	5	8	8†	8⅜ — 9⅛	..	4 6 6
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
B. Columbia Elec. Rly., Def.	100	8	8†	141 —144	+1	5 11 1
Do. Pref. Ord.	100	6	6	125 —130	..	4 12 4
Do. 5 % Pref.	100	5	5	113½—114½	..	4 7 4
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98½—101½ xd	..	4 8 8
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	102½—104½	+ ½	4 6 2
Calcutta Trams, Ord.	5	5	..	6 — 6¼	..	4 16 0
Do. 5 % Pref.	5	5	5	4⅛ — 5⅛	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	Nil	2½†	⅜ — ½	..	..
City Buenos Aires Trams (1904)	5	5	5	5⅝ — 5⅞	+ 1/16	4 5 1
Do. 4 % Deb.	100	5	5	101 — 103	..	4 17 3
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	⅜ — ⅝	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94	..	5 6 5
Do. 6 % B Deb.	100	5	6†	56 — 60	..	10 0 0

La Plata Elec. Trms, Ord.	1	..	..	0— 1/16	−1/16	..
Do. Pref.	1	6	6	38— 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	95 — 99	..	5 1 0
Madras Elec. Tr. (1904), Deb.	100	5	5	96½ — 98½	..	5 1 6
Manaos Trams & Lt., 1st Deb.	100	5	5	93 — 96	..	5 4 2
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½—102½	+1	4 17 7
Mexico Trams Com.	$100	7	7	120 —122 xd	+3½	5 14 9
Do. Gen. Con. 5 % Bonds	..	5	5	96 — 98	..	5 2 0
Do. 6 % Bonds	100	6	6	101 —103	+ ½	5 16 6
Para Elec. Rlys. & Lt., Ord.	5	10	10	7⅛ — 7⅜	+ ⅛	6 13 4
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	7 0 4
Do. 5 % 1st Deb.	100	5	5	98½—100½	+ ½	4 19 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 1/16 — 1 1/16	..	1 18 1
Do. 5 % 1st. Deb.	100	5	5	101 —104	..	4 16 2
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅝	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	99 —101	+1	4 9 1
Rio de Janeiro Trams	$100	4½	5†	123½—124½	+3	4 0 6
Do. 1st Mort. 5 % Bonds	..	5	5	104 —105	+ ¼	4 15 3
Do. 5 % Mort. Bonds	100	5	5	97½— 98½	+ ½	5 1 9
Sao Paulo Tram, Lt. and P.	$100	10	10†	208 —211	+6½	4 14 2
Do. 5 % 1st Deb.	$500	5	5	104 —106	..	4 14 4
Singapore Trams, 5 % Deb.	100	5	5	79 — 82	..	5 19 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	93 — 95	..	5 5 8
Un. Elec. Trams Monte Video	5	6	7	5¾ — 6	..	6 1 11
Do. 6 % Pref.	5	6	6	5¾ — 5⅞	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	101 —104	..	4 16 2
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	103½—105½	..	4 5 4

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	⅜ — ½	..	..
Do. 6 % Pref.	1	9	6	8⅞ — 9⅛	..	7 2 2
Babcock & Wilcox	1	26	28	68 — 72	..	4 1 5
Do. Pref.	1	6	6	1⅜ — 1½	..	3 13 10
B.I. & Helsby Cables	5	10	10	6⅞ — 7⅛	..	6 18 0
Do. Pref.	5	6	6	5½ — 6½	..	4 16 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	92 — 95	..	4 13 9
British Westinghouse, Pref.	3	Nil	..	¾ — 1	..	Nil
Do. Deb.	100	4	4	63 — 66	+1	6 1 3
Do. 6 % Prior Lien	100	6	6	99 —102	..	5 17 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — ¼	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — ¼	..	Nil
Do. 4½ % Deb.	100	4½	4½	54 — 59	..	7 10 6
Do. 4½ % Second Deb.	100	4½	4½	37 — 42	..	10 14 4
Callender's Cable	5	15	10†	10⅜ — 11⅛	..	6 18 6
Do. Pref.	5	5	5	5 — 5¼	..	4 15 3
Do. Deb.	100	4½	4½	98½—100½	+ ½	4 9 7
Castner-Kellner	1	17½	20	8¾ — 8¾	..	5 6 8
Do. Deb.	100	4½	4½	105 —109	..	4 10 7
Crompton & Co.	3	Nil	Nil	⅛ — ¼	..	Nil
Do. Deb.	100	5	5	68 — 68	..	7 7 1

Dick, Kerr	1	5	..	37 — 39	..	5 3 1
Do. Pref.	1	6	6	11⅝ — 12⅛	..	5 12 11
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £3 paid	5	Nil	..	⅜ — ⅝	−1/16	Nil
Do. fully paid	5	Nil	..	1⅞ — 2⅛	..	Nil
Do. 4 % Deb.	100	4	4	70 — 74	−1	5 8 1
Do. 5 % Second Deb.	100	5	5	75 — 78	..	6 8 2
Electric Construction	2	Nil	2½†	¾ — 1	..	..
Do. Pref.	2	7	7	1⅝ — 1⅞	..	7 9 4
Greenwood & Batley, Pref.	10	7	7	7¾ — 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	9 — 9½	..	5 5 3
Do. Deb.	100	4	4	85 — 90	..	4 8 11
Henley's, Ord.	5	15	10†	11½ — 12½	..	6 2 6
Do. Pref.	5	4½	4½	4⅛ — 5⅛	..	4 6 9
Do. Deb.	100	4½	4½	104 —106	..	4 4 11
India-Rubber, G. & T.	10	10	..	9½ — 10½	— ½	..
Do. Pref.	10	5	5	9¾ — 10½	..	4 17 7
Telegraph Construction	12	20	10†	83 — 85	..	6 16 2
Do. Deb.	100	4	4	99½—101½	..	4 9 0
Willans & Robinson	1	Nil	..	1/16— 1/8	..	Nil
Do. Pref.	5	Nil	..	⅞ — 1½	..	Nil
Do. Deb.	100	4	4	59 — 61	..	6 11 2

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 3½ per cent., February 8th, 1912.

PROCEEDINGS OF INSTITUTIONS.

The Diesel Oil Engine and its Industrial Importance, particularly for Great Britain.

By Dr. Rudolph Diesel.

(Abstract of paper read before the Institution of Mechanical Engineers, *March 15th*, 1912.)

The Diesel oil engine has been proved to be a most reliable engine when properly built, the working of which is quite as safe as that of any other system of prime mover; it is even more simple, since it does not require any auxiliary apparatus, and since the fuel in its natural and original form, without having previously undergone any transforming process, is directly converted into work in the cylinder of the engine. To-day the thermal or indicated efficiency reaches 48 per cent. in this engine, and the effective or brake efficiency reaches, in some cases, 35 per cent. of the heat value of the fuel.

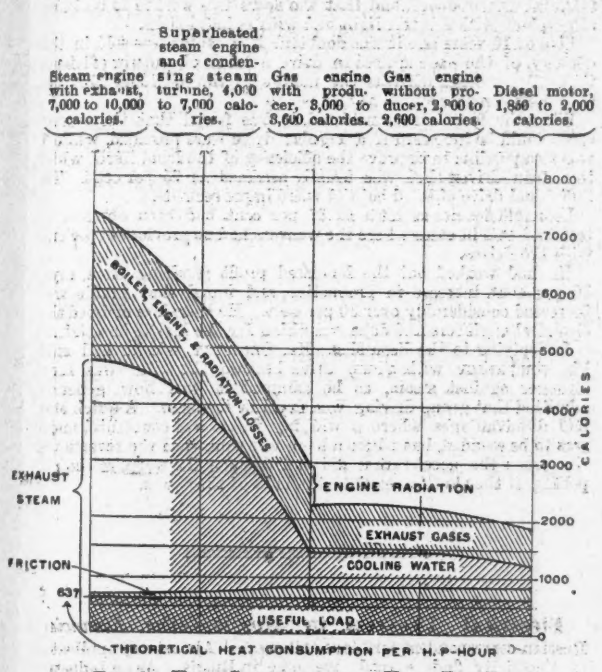

Fig. 1.—Heat Consumption of Heat Engines.

Fig. 1 shows the heat utilisation for 1 B.H.P.-hour in the different kinds of prime movers known to-day. With our present scientific knowledge, any considerably higher efficiency in the process of transforming heat into mechanical work is not obtainable. Further progress seems only possible with some other method for transforming heat into work.

The Diesel engine is therefore the engine which converts the heat of the natural fuel into work in the cylinder itself, without any previous transforming process, and which utilises it as far as the present standard of science permits; it is therefore the simplest and, at the same time, the most economical prime mover.

These two facts explain its success; it lies in the new principle of the internal working process and not in constructional improvements or alterations of older types of engines. Further, the Diesel engine has broken the monopoly of coal, and has solved the problem of using liquid fuel for power production in its simplest form, making hitherto unutilised products of nature available for motive power. It has thereby exercised a far-reaching influence on the liquid fuel industry, and owing to the interest which petroleum producers have taken in this important question, new sources of petroleum are continually being developed and new oil districts discovered. It has been proved by recent geological researches not only that there is probably on the globe as much liquid fuel as coal, but also that it is more conveniently distributed as regards its geographical position (fig. 2). These facts, which are indisputable nowadays, have gradually silenced those who objected to too great a development of the Diesel engine for fear of lack of fuel.

The by-products of coal distillation and coke plants, such as tar and creosote oils, can be utilised with the same satisfactory results as with natural liquid fuels.

As tar and tar-oils are from three to five times better utilised in the Diesel engine than coal is in the steam engine, a much better and more economical utilisation of coal is obtained if, instead of being burned under boilers on grates in a wasteful way, it is first transformed into coke and tar by distillation. Coke is used for metallurgical and other general heating purposes; from a part of the tar the valuable by-products are first extracted, and undergo further processes in the chemical industry, whilst the tar-oils and combustible by-products, and a great part of the tar itself, are burned in the Diesel engine under extraordinarily favourable conditions.

It is also possible to burn vegetable and animal oils in the Diesel engine. It has been proved that Diesel engines can be worked on earth-nut (Arachis or peanut) oil without any difficulty, and the author is in a position to publish, on this occasion for the first time, reliable figures obtained by tests: Consumption of earth-nut oil, 240 grammes (0·53 lb.) per B.H.P.-hour; calorific power of the oil, 8,600 calories (34,124 B.Th-U.) per kg., thus fully equal to tar oils; hydrogen, 11·8 per cent. This oil is almost as effective as the natural mineral oils, and as it can also be used for lubricating oil, the whole work can be carried out with a single kind of oil produced directly on the spot. Thus, the engine becomes a really independent engine for the tropics.

The fact that oils from vegetable sources can be used may seem insignificant to-day, but such oils may, perhaps, become in course of time of the same importance as some natural mineral oils and the tar-products are now.

They make it certain that motor power can still be produced from the heat of the sun, which is always available for agricultural purposes, even when all our natural stores of solid and liquid fuels are exhausted.

The engines, which have been built in various factories and in various countries, still remain almost an exact copy of the old experimental engine.

A remarkable fact is that the first Diesel engines, built in 1897-98, are still working, without any change in their fuel consumption; also the first English engine built by the Mirrlees, Watson & Yaryan Co., at Glasgow, according to the author's design of 14 years ago is still working.

As the central electric stations took up the Diesel engine very early, the necessity for quicker running engines arose. This need, and the improvement in methods of construction and utilisation of materials, caused the gradual introduction of the quicker running four-stroke cycle engines, with speeds of from 300 up to 600 revolutions. The weight of the engines was reduced to about one-fourth to one-fifth of the weight of the old types, or to about 50 kg. (110 lb.) per H.P. Engines of this kind are now built up to about 700 H.P., and are especially suitable for driving dynamos, blowers and centrifugal pumps, and also as auxiliary engines on board large vessels, &c

Small engines have recently been built in accordance with the author's designs. A 5 H.P. one-cylinder plant, designed in 1909, for 600 R.P.M., consumed 240 grammes (0·53 lb.) B.H.P., which is, therefore, not much more than with the old large engines of medium horse-power. At present the author is endeavouring to simplify and strengthen this small engine.

After vertical engines had solely been used for about 12 years, horizontal four-stroke cycle engines were built. The first horizontal engines were practically only vertical engines laid on their sides without any independent structural innovations; but gradually the designers freed themselves from the tradition of the vertical engine, and some details were altered in such a way that they were more suitable for the horizontal position. A type of engine was thus obtained which is hardly distinguishable from the horizontal gas engine. In the engine made by the Swiss Locomotive Works, Winterthur, the inlet valves are no longer placed in the cover, but on the side of the cylinder as in gas engines, and are directly driven from the longitudinal camshaft. A cross camshaft is no longer used. Only the fuel and exhaust valves are left in the cover, while the air compressor is arranged in another way

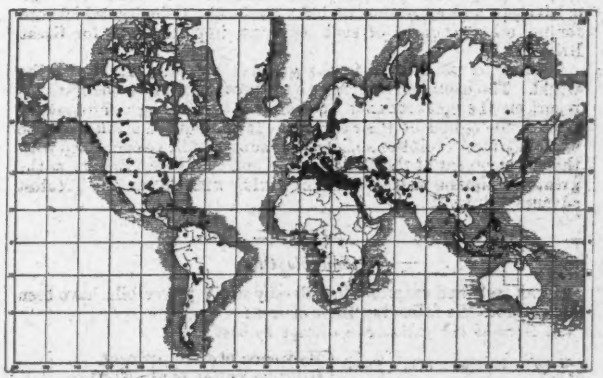

Fig. 2.—Petroleum Fields of the World in 1908.

These designs are to-day very often used for small plants of 20 H.P. and more. But the M.A.N. built such horizontal Diesel engines for very large horse-powers as double-acting four-stroke cycle engines with two or four cylinders arranged tandem. The largest engine of this kind so far is a double-acting four-stroke cycle tandem twin engine, of 1,600-2,000 H.P. or 400-500 H.P. per cylinder, with a speed of 150 R.P.M.

As very often stated by the author, the Diesel principle is essentially suitable as a two-stroke cycle engine, because the scavenging is not done with a fuel-air mixture, but with pure air, so that not only untimely ignitions but also fuel losses are avoided, and the scavenging can be done more effectively, and with almost any quantity of air desired.

Successful attempts to construct a two-stroke cycle Diesel engine on entirely new lines have been made recently by Messrs. Sulzer Bros., of Winterthur, working entirely on the original Diesel principle. The four-stroke cycle engine still has a better combustion and a more economical fuel consumption, and is

simpler in its method of working. It thus remains the standard engine, and still predominates for medium-sized stationary plants up to 500 or 600 H.P. On the other hand, the two-stroke cycle engine with its smaller cylinders has now come into favour for stationary plants of higher horse-power, and, as a marine engine, has become the only standard type.

Two considerably different fundamental types of two-stroke cycle engines have so far been competing. The first is the engine made by Messrs. Sulzer Bros., with separate scavenging pump. The second—the M.A.N. engine—was brought out much later; in it the scavenging pump, which has an annular piston, is placed underneath each combustion cylinder. Both engines are single-acting.

A two-stroke cycle engine of an entirely new type has been recently built by Prof. Junkers on the lines of the old Oechelhäuser gas-engine, with two pistons working in opposite directions in one cylinder but acting on the Diesel principle. A horizontal 1,000-H.P. engine of this kind is at present being tested.

At present it is generally agreed that the four-stroke cycle engine from 5 up to 600 H.P. may be regarded as the exclusive type for stationary plants; but it will probably not remain so much longer in spite of its perfection, in view of the development of the two-stroke cycle engine, especially of the double-acting type.

The use of the two-stroke cycle engine has increased slightly, but it is to be hoped that it will be still further extended. Although this engine may never equal the four-stroke cycle engine as regards thermal efficiency, its initial cost is so much lower that its slightly higher fuel consumption will be more than counterbalanced by the greater interest and amortisation on the higher-priced four-stroke cycle engine. When this stage is reached, the question is simply one of economy. In the author's opinion the two-stroke cycle engine will thus soon make headway for stationary plants.

As to the importance of the Diesel engine, especially for Great Britain, the three following facts must be borne in mind:—

1. Great Britain is an exclusively coal-producing country;
2. Great Britain has the largest Colonial Empire in the world; and
3. Great Britain is the greatest shipping nation in the world.

England has the greatest interest in replacing the coal-wasting steam engine by the more economical Diesel engine, first, because she can therewith effect enormous savings in her most valuable treasure—coal—and thus defer the exhaustion of her stock; and secondly, because she can run her coal industry and the independent chemical industries on more economical lines, when using the coal in the more rational and refined way, as already mentioned. Finally, she will also make herself free and independent of foreign markets for the supply of liquid fuels by using coal in this way, that is, by working the tars and tar-oils in the Diesel engine.

The Diesel engine is the predestined Colonial engine, because only about the fourth or sixth part of weight in fuel has to be transported for it to the Colonies and their hinterlands, as compared with the steam engine. For a Colonial engine the cost of freightage for fuel is generally the determining factor. Further, the transport of these liquid fuels is considerably easier and more convenient than the transport of coal, especially when tank-vessels and pipe-lines are used.

If one also considers that the Diesel engine can utilise vegetable oils, entirely new prospects are brought to light for the cultivation and expansion of industry in the Colonies, which are for no other country of such eminent importance as for Great Britain.

Finally, Great Britain is the greatest shipping nation in the world. The captains who have had Diesel engines on their vessels report on the great security and comfort in working; shipbuilders publish the figures of their savings. It is unquestionable that one of the greatest evolutions of modern industry will be connected with this development of the Diesel engine, and that Great Britain, as the greatest shipping nation of the world, will derive the greatest advantage from it.

Appendix.

Suitable Oils.

From tests and examinations already made, power oils have been divided into the following three classes:—

1. *Normal oils which can always be used:*

(*a*) Mineral oils freed from benzene (gas oils).	Hydrogen over 10 per cent. Calorific power over 10,000 cal. (39,680 B.TH.U.). No solid impurities.
(*b*) Lignite tar oils.	Hydrogen over 10 per cent. Calorific power over 9,700 cal. (38,489 B.TH.U.).
(*c*) Fat oils from vegetable or animal sources.	Scarcely any researches have been made on these. Earth-nut oil has 11·8 per cent. hydrogen, and calorific power 8,600 cal. (34,124 B.TH.U.).

2. *Oils which can be used only with the aid of special apparatus:*—

(*a*) Pit coal-tar oil.

(*b*) Vertical-oven water-gas and oil-gas tars, probably also coke-oven tars.

General characteristics: Hydrogen not over 8 per cent.; amount of free carbon not over 3 per cent.; residue on coking not over 3 per cent.; calorific power not under 8,600 cal. (34,124 B.TH.U.).

3. *Oils which cannot be used:*—

Tars from horizontal or inclined retorts.

The Individual Electric Drive for Looms.

A MEETING of the Lancashire Section of the British Association of Managers of Textile Works was held in the Victoria Hotel, Manchester, on March 30th, when a paper was read by MR. J. F. CROWLEY on this subject. The author described the installation at the Wellfield Mill, Bradley Fold, consisting of 700 individually-driven looms; the entire electrical equipment was carried out by Messrs. Siemens.

Careful and elaborate tests of individual electric driving against steam driving and group electrical driving having been carried out by the proprietors of the shed, Messrs. Frears, Lord & Brother, a decision was arrived at that an increase had been obtained of 10 per cent. in production by means of individual motors, and another shed had been similarly equipped in consequence. It was claimed for the shed (which took power from the mains of the Lancashire Electric Power Co.), that owing to the lighter walls, lighter roof, fewer pillars, &c., it had cost £8 per loom less to erect and equip than a steam-driven shed of the same capacity. In addition to the reduced capital outlay and to the increased production, which had a marked effect upon the profits, it was claimed that an improved material was produced, and that the operatives worked in a clearer atmosphere with a better light and with reduced risks.

Five or 10 years ago it was doubtful if a motor was sold in this country, of the size required to drive a loom, of greater efficiency than 70 per cent., whereas the motors at the Wellfield Mill had shown efficiencies as high as 88·5 per cent.

When the loom was considered, it was found that the average speed could be increased if a regular drive were provided, while it was also possible to improve the efficiency of the loom itself, which in a steam-driven shed was usually assumed at 75 per cent. The individual drive effected both of these improvements.

Loom efficiencies as high as 87 per cent. had been obtained on test, and this in cases where the weavers had no previous experience with the drives.

He had worked out the increased profit resulting from, say, a 10 per cent. increase in production, and found that profits were increased considerably over 30 per cent. He therefore claimed that electrical engineers had done something for the textile industries.

In replying to the discussion, MR. CROWLEY said he had made his comparison with group drive because the case was much stronger against steam, as he assumed it was now generally admitted that group driving was superior to steam. A quick start had disadvantages where a warping frame was concerned, and it was to be avoided, but where a loom was concerned the reverse was the case: the acceleration did not damage the warp, as the propelling of the shuttle absorbed the bulk of the power.

Electrical Progress in Russia.—The *Financier's* Russian correspondent writes as follows:—"Almost any application of electricity finds a ready welcome in Russia. As an industrial country she may be said to have come into prominence with the advent of industrial electricity, and a study of the country will show that whereas the application of coal gas is on a very limited scale indeed, the number of electrical stations, both for lighting and power, east, west, north and south, can be counted in hundreds. A very large proportion of these is public property, although many of them belong to private individuals, and the foreigner's share of these is remarkably large. It is astonishing to read the large number and importance of electrical concessions, principally for and including tramway exploitation, that are held by Belgians, who are said by some patriotic Russians to hold the Russian tramway industry, with a few notable exceptions, practically under their control. Without referring to the already well-established telegraph system by wire, there is a remarkable tendency to extend the telephone system all over the country, mostly under the control of public authority. Although electricity is so largely used in the direction indicated above, it is not so firmly established as a source of power for factories. It is, however, more widely applied amongst the mines than is generally imagined."

South African Contract.—A Cape correspondent writes:—"On Feb. 22nd the Kalk Bay Municipality called for tenders for five sections:—Transformer pillars, meters, cables, poles, and feeder panel. Tenders were to be in on March 7th, and it was then found that delivery on most of the stuff was uncertain owing to the coal strike. Up to the time of writing only two sections have been definitely settled. The transformer pillars and switchboard extensions will be carried out by the South African General Electric Co., the pillars themselves being made locally by the Clyde Engineering Works, Cape Town. Most of the switchgear, &c., will be supplied from Johannesburg stock, so that a fairly early delivery has been promised."

Under False Pretences: Sentence.—At the Surrey Quarter Sessions, Walter Charles Edward Hagreen (20), engineer, of Atherton House, Ham, was sentenced to 18 months' hard labour for having obtained by false pretences (1) a gas engine from the National Gas Engine Co., valued at £19 10s.; (2) an electric clock from Frank Hope Jones; (3) and two motor tires from Dennis Gayford. According to the evidence given, prisoner posed to be trading under the name of W. C. E. Hagreen & Co., specialists in motor-car and launch lighting. None of the articles were paid for by prisoner, who had sold them much under cost.

REVIEWS.

Liquid Fuel and Its Apparatus. By W. H. Booth. London: Constable & Co., Ltd. Price 8s. 6d. net.

Mr. Booth's book, which is based on his larger work dealing with liquid fuel, comes at a time when more attention is being paid to the subject than has ever previously been the case, and for that reason, if for no other, a warm welcome will be accorded to this volume.

Mr. Booth has divided his book into three parts, in the first of which he deals with theory and principles, and in the second with practice, while the third contains a series of useful tables. As is perhaps somewhat natural in a work which has to some extent been adapted from a larger treatise, the book lacks continuity in certain parts, but this has not prevented the author from including a really enormous amount of valuable information, particularly in the section relating to practical operation. It is true that in some places Mr. Booth seems to have gone too much into elementary detail, but no doubt this was done in order to make the book more complete.

Plenty of comparisons are given between the use of coal and oil under various circumstances for firing marine, locomotive and stationary boilers, and in almost every case the comparisons are adduced by weight. Such figures are the only ones of use for scientific purposes, but some instances might have been given with advantage, as to the actual financial economies which have been effected by the employment of liquid fuel instead of coal, taking into consideration original cost, repairs and running charges.

The chapter on the storage and distribution of liquid fuel will be found particularly valuable and accurate in all its details, although some mention of the difficulties involved in carrying fuel oil in the double bottom of a ship might have been described; the question of the relative advantages of steam and compressed air for atomising the oil is very ably dealt with. In the last chapter, Mr. Booth discusses the question of liquid fuel for oil engines, and might with advantage have written at much greater length on this matter, in view of the importance which the oil engine, particularly of the Diesel type, has now attained. If this be done when a further edition of the work becomes necessary, it will certainly appeal to a much wider circle of readers, and one which is increasing rapidly every day.

The tables which are given at the end of the volume will be found of much practical value, dealing, as they do, with the properties of many classes of fuel oil, and the idea of grouping all such tables together in a compact form is much to be commended.

An Introduction to the Study of Fuel. By F. J. Brislee. London: Constable & Co., Ltd. 1912. Price 8s. 6d. net.

This book is one of the publishers' series of outlines of industrial chemistry. Being concerned with the chemistry of fuel it fittingly made its appearance on the day when Great Britain was face to face with a fuel famine. Until within quite a few years ago very little was known of the chemistry of fuels outside the narrow circle of metallurgy. To-day so many men are imbued with a sense of the importance of purchasing fuel by its calorific capacity that there is no small danger of this important factor being overweighted to the neglect of other matters, in their way equally important. The value of a fuel is not the same to every user, for so very many factors enter into the problem.

In the book under review the writer does not so much take up the practical side, except so far as concerns the chemistry of fuel, the determination of temperatures, the analysis and volumetric calculation of the products of combustion, and the explanation of the various instruments used for the above purposes. The first six chapters are given to chemistry and physics, and the reader will find in Chapter V explanations of pyrometers and general high-temperature determinations.

In Chapters VII and VIII the natural and the artificial solid fuels are treated of. American tests of briquette fuel are said to have shown less smoke than natural or untreated coal, which is somewhat contrary to the experience on this side, especially in the case of the fuels used for Continental locomotives, which are excessively fuliginous.

Three chapters are given to gaseous fuels, their occurrence, manufacture and theory, and one chapter to gaseous explosion and the so-called explosion engine. The final chapter on liquid fuel is brief, and is preceded by three chapters on air supply and draught, furnace efficiency and fuel economy, and boiler testing. There are five brief appendices.

Students of the gas producer will be interested in the treatment of this apparatus whose produce, in its ratios of output of CO and CO_2, is governed by the temperature which is allowed. Engineers generally will perhaps more especially value the section on temperature measurements. In the table on page 101, there is surely a mistake in the figures in the first line?

The engineering student will find this book very useful in bringing into view the general principles involved in the combustion of fuel and other matters pertaining to combustion. To the engineer who has not made a youthful study of the chemistry of fuel it will be useful also, owing to the efficient way in which the subject is presented to him.

NOTES ON MAINTENANCE OF THE DIESEL ENGINE.

[CONTRIBUTED.]

There are so many Diesel engines now in use that the following notes may be of interest to brother engineers.

After two years' experience of this class of engine, the writer has no hesitation in saying that such engines are quite reliable for central-station work; any trouble experienced at first was entirely due to lack of experience on the part of those in charge.

Unless the valves, &c., are kept in practically perfect condition, trouble will be experienced in starting, as the engine depends entirely on the compression for firing the charge; some engineers will consider this an advantage, but it is a serious matter for a supply station should an engine fail to start when the load is rushing on.

Where one engine only is installed, the question of the starting air is of great importance, and a small compressor, driven independently of the engine, is almost a necessity. Where there are more engines than one, it is not likely that all will be out of order at the same time, and the supply of air is practically assured.

The engine most likely to fail to start is the single-cylinder type, the multi-cylinder engine being almost certain to run on one cylinder unless allowed to get into a very bad state. Therefore, the question of the supply of air is not so serious in this case.

In a residential district the noise of the exhaust may be objected to; while it is by no means excessive, the persistent rap is objectionable, especially at night.

In a case with which the author is familiar this was overcome by taking the exhaust into a pit, 10 ft. by 6 ft. by 6 ft. deep, which was available, the outlet being through the silencer supplied with the engine, and it is now almost impossible to tell when the engine is running. In addition to the reduction of noise the back pressure on the engine was considerably reduced.

The engine ran for some time without trouble, the first failure to start being due to the exhaust valve buckling slightly, making it impossible to get the compression high enough for ignition.

The exhaust valve casing worked loose several times, and when it was tightened down hard the casing itself buckled; each of these events meant failure to start and loss of air. In one case the air pressure was as low as 200 lb. in one starting receiver and 450 lb. in the reserve, while there was 650 lb. in the blast receiver; even with this low pressure it was possible to start up on pure paraffin.

This trouble was overcome by having the shoulder of the valve casing turned down a little from the top of the seating.

The exhaust valve soon gets pitted and scored, and it requires grinding in about every three months on an engine running

six or seven hours per day. It is only a matter of a quarter of an hour to change this valve, a spare valve and casing being supplied with the engine and a split lever allowing this to be removed without disturbing the other valve gear.

The air valve has given very little trouble, although it requires occasional grinding in, and once was badly "gummed up" with imperfectly consumed fuel; the cause of this is mentioned later.

As regards the fuel valve, the makers appear to consider that it requires more attention than other parts, but during two years' working this valve has given no trouble. It has been regularly cleaned and rubbed in once or twice with knife powder when overhauling the engine.

The starting valve stuck open several times when starting up and completely emptied one of the air receivers. This was found to be due to an accumulation of moisture in the receiver being carried into this valve and causing the spindle to rust and stick in its casing. The trouble was overcome by giving careful attention to the draining of the intercooler while the engine is running, and regularly draining the air receivers each day.

The lubrication of the compressor gave some trouble at first, because of the high-pressure valves occasionally sticking and causing a shut-down owing to the falling of the blast pressure, and the air pipe from compressor to intercooler becoming blocked by carbonised oil; the makers recommended that the oil supply to the high-pressure piston should be discontinued altogether, except for a few minutes after starting up, and this was found quite sufficient for lubrication and completely overcame the trouble.

The lubrication of the engine has given no trouble except for the piston, which requires careful attention. In most vertical-type engines the oil is pumped into an annular space round the cylinder and reaches the piston through some six very small holes in the cylinder liner; these appear to be very liable to get blocked up and as it is necessary to dismantle the whole of the valve gear and draw the piston, to enable an inspection to be made, they are liable to be overlooked.

The piston has run dry twice in the two years, although drawn every six months for inspection, and in each case two of the holes were found blocked up. Fortunately the driver noticed the trouble before any damage was done to the piston.

The fuel pump valves require careful attention, and particularly the suction valve, as any leakage past this will prevent the engine developing full power. Failure to start has resulted more than once through the suction valve casing working loose on its seat; this was not an easy fault to locate the first time it occurred.

The cooling water must be carefully watched, and it is suggested that the circulating pump, driven from the engine, is not sufficient, but that a supply should be available to continue a flush of water through the engine for about fifteen minutes after shutting down. The reason advanced is that the heat of the piston and cylinder walls is sufficient to bake any sediment left by the water into a hard scale. This assumes that the water runs out of the engine when the pump is stopped.

A cracked cylinder cover was another unexpected trouble, and the writer believes that this has occurred on more than one engine of this type. The only reason which has been suggested for this is that the engine must have been seriously overloaded or that scale had formed in the water passages, and the latter point will be definitely settled by opening up the damaged cover.

The crack was so slight that some difficulty was found in locating the trouble. The engine failed to start and the usual examination was made, all valves were ground in and rocker lever clearances set. The engine started up sluggishly on pure paraffin and ran as usual, but refused to start on ordinary fuel oil.

Indicator diagrams were taken (the engine again being started on paraffin) and the compression was found to be very low. A careful examination revealed a tiny crack on the seating for the exhaust valve casing, extending through to the seating of the fuel valve casing. On one side of the crack the seating was slightly raised, preventing the exhaust valve casing from bedding properly.

During the few hours the engine was running on this low compression, the whole of the valves and cylinder head were gummed up with imperfectly burned oil.

It will generally be found that the engine will be somewhat sluggish in starting when anything is getting out of order, it is therefore a simple matter to get things right before a failure to start occurs. Naturally one must have practical experience of the peculiarities of Diesel engines to ensure their absolute reliability.

The freedom from accumulation of carbonised material on valves, piston, and cylinder, is remarkable, and very little trouble is experienced in cleaning up when overhauling. The maintenance cost is also low, and is chiefly confined to the pipes and valves dealing with the compressed air. The high pressures used cut the valves at a rather serious rate.

There has been no falling-off in efficiency, and the ease with which the exact cost per unit can be ascertained each day is very different to the practically guesswork method of the smaller steam power stations.

More lubricating oil is required than with a steam engine only, but if the auxiliaries of the steam plant are included, there is little difference; it will be found better not to depend too much on oil filters, as they do not appear to separate out the carbon properly.

The writer cannot speak from experience of long non-stop runs, the longest coming under his personal observation being of 120-hours duration. There is no reason to doubt that very long runs are possible, the only limit being the length of time the exhaust valve would remain good enough to retain the high compression necessary.

No mention has been made of fuel costs, as these are so well known, and it is sufficient to say that the maker's guaranteed figures are still maintained under working conditions.

OIL ENGINES FOR DRIVING SMALL GENERATORS.

[CONTRIBUTED.]

In connection with a large number of private electric lighting installations, such as are supplied for lighting country houses, farms and similar purposes, the use of the vertical high-speed oil engine direct-coupled to a small electric generator has become standard practice. Although it may be safely said that this constitutes one of the simplest types of power plant, from the operating and maintenance point of view, that could possibly be applied to such a purpose, and although it is admirably suited for isolated positions, on account of the ease of getting fuel, without incurring a very heavy capital cost for plant, there are one or two practical points in the running of even such a simple plant as this, which may possibly with advantage be related for the benefit of other engineers in charge of similar installations.

It will very often be found that insufficient care has been taken in an installation such as is mentioned above for, say, country house lighting to secure a proper location for the generating plant. It will sometimes be found that the oil engine and dynamo, together with the main switchboard, are stuck away in some outhouse, which is only suitable for the purpose because there is a roof over it. It is hardly to be expected that even well-made plant will run continuously when the scale of attention paid to it is on a par with this accommodation. In one such plant which was installed in the above-described type of outhouse, considerable difficulty was experienced in starting-up the engine, more especially in cold weather, and this was ultimately traced to the fact that moisture formed on the sparking plugs owing to the damp nature of the room in which the engine was placed. The condensation of water on the porcelain insulators was abundant evidence that the engine was kept in a place that was damp, and as the building was not artificially heated it became necessary to rig up some sort of arrangement to prevent the deposition of moisture on these insulators, as it was quite a business to start

the engine up. It was at first thought that it might be worth while to put a slow-combustion stove in the building, but apart from the doubt whether the man told off to look after the place would stoke often enough to keep the room at a moderate and uniform temperature, there was also the question whether some fumes would not escape from the stove into the room, and get at the exposed metal of the engine and dynamo. As, however, there was a storage battery in connection with the plant, used for day load, an electric convector was obtained and placed close to the engine so that the hot stream of air passed near the magneto, and presumably near the rest of the electrical fittings of the engine. The current taken by the convector was not excessive, but was sufficient to maintain the engine room at a moderate degree of warmth even in the coldest weather, and this put an end to trouble from deposition of moisture.

Another incident which may be of interest in this connection, and which at first was thought to be due to the weather, was as follows: It was found on starting-up a small oil-driven generating set in the morning that a certain amount of water was ejected from the exhaust, more especially for the first few strokes. No notice was, at first, taken of this, as it was put down to condensation in the silencer of the engine. As, however, it seemed to persist, and indeed grew a little worse day by day, it was decided to take down the engine and see what was really the matter. On examining the water jacket, it was found that there was a slight leak in it, which would probably in course of time have developed to disaster if the thing had been allowed to go on for long. From this it may be learnt that any large quantity of water coming from the exhaust of such engines may possibly indicate a fault either in the castings or in the connecting-up of the water-cooling system.

One of the chief causes of trouble in these small oil-engine generating plants is the gradual loss of power due to the lowering of the compression, and this, again, is simply due to lack of attention, as the loss of compression becomes inevitable if the valves become uneven or pitted on their surfaces. In order to prevent this trouble from becoming serious, a rule should be made that the valves must be taken out and ground in on their seatings periodically, so as to preserve them in a gas-tight condition between the head and the seatings in the cylinder. After removing the valves, all the carbon deposit which will be found on both the valve and its seating should be carefully scraped off, and then a small amount of emery powder mixed with oil should be applied to the valve. This, when replaced in the cylinder without the spring being fitted, should then be turned briskly round and round with a screw motion, the valve being occasionally lifted from its seat while the grinding is in progress. When this has been done and the valve and seating has been brought up to a true surface again, care should be taken to remove all traces of emery from the valve, seating, and guides by washing them out with paraffin oil or petrol. In some cases carborundum powder of the finest grade has been adopted in place of emery for this purpose, as it cuts more quickly than emery, and some engineers, therefore, prefer it. Only a very little of the carborundum mixture should be used at a time, or it will be found that a bad surface will be obtained. If, on opening up the engine, which has shown signs of very bad compression, it is found that the valve and seating are in a very bad state, due to inattention, it is best not not to rely upon hand-grinding as above, but to place them in a valve-truing and seating tool, several types of which are at present on the market for this purpose. If, however, great care is taken to see that the valves are periodically ground up true, there will be no need for drastic measures. It will be found, on the average, that the exhaust valves will have to be reground twice as often as the inlet valves, probably on account of the fact that the hot gases, in their escape, have a scouring action on the surfaces of the valve and seating.

There are, however, not very many things to go wrong with the small oil-engine-driven plant such as is used for small power generating purposes, provided that ordinary care and attention are paid to the running. The above notes may be of sufficient interest to warrant attention on the part of those who might otherwise think that they had got hold of a perpetual-motion machine.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

"Adams Igranic" Multiple Toggle-Joint Lever Starter.

To start a motor whose normal full-load current is 1,000 amperes, demands a very special starting switch. Sliding contacts are useless for this purpose, for the reason that however carefully the starting handle is moved, there must necessarily be a moment on cutting out each section of resistance when contact is made on an inadequate area, with consequent heating and burning of the surfaces. In the "Adams Igranic" multiple-lever starter (fig. 1), made by the Adams Manufacturing Co., Ltd., Bedford, no sliding contact at all is used. At each step contact is made by pressing a laminated copper brush against a hard-rolled metal surface, with the result that when any contact at all is made, it is over the whole surface. Partial contact is impossible. The switches are closed, one after the other, by toggle-joint levers, thus enabling a large brush to be thoroughly pressed home with a

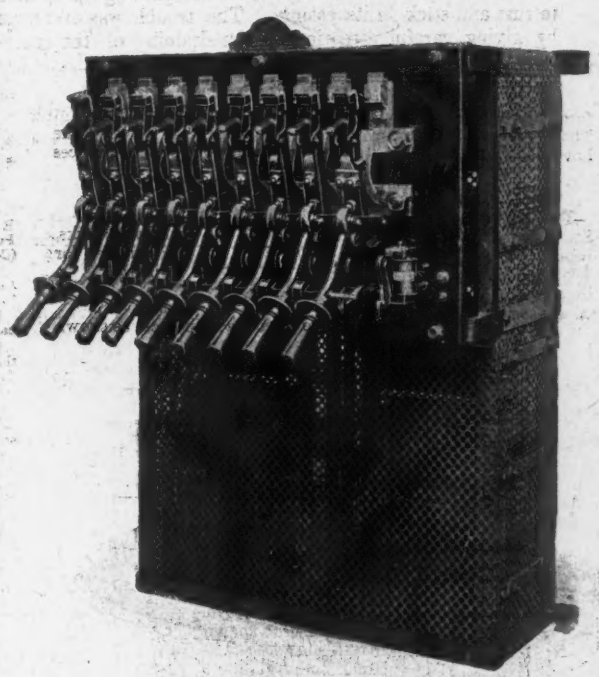

Fig. 1.—"Adams Igranic" Starter for 600-h.p. 500-volt Motor.

comparatively slight physical effort. Each switch has a heavy auxiliary sparking contact which thoroughly protects the laminated brush against damage. Each switch when closed short-circuits a section of the starting resistance, and the switches are all mechanically interlocked in a way that makes it impossible to close them in any but the proper order. As each switch has to be held in till the next is closed, the operator is compelled to manipulate the starter with a hand-over-hand action, which effectually prevents too rapid starting. The final lever is held in by a magnetic detent, which releases and lets all the switches open on a failure of voltage. Starters of this type are standardised up to 10,000 amperes capacity.

Electric Lamps for the Police.

The objections to the use of oil lamps by policemen—the smell and fumes, and damage to the clothing—are so obvious that the superiority of the portable electric lamp for their purposes is undeniable. In view of the high quality of the latter as now manufactured, and the durability of the accumulators (some police forces are still using the same electric lamps that were supplied four years ago, and the cost of renewals of parts shows a saving on the cost of oil alone), there can be no doubt as to the wisdom of adopting the electric lamp for police work.

Messrs. L. E. Wilson & Co., of 20, Cross Street, Manchester, have made a special study of this class of work, and have recently introduced a new type of lamp which is being adopted by some of the police forces of this country. The lamp as illustrated, fig. 2, is fitted with a 2-volt unspillable accumulator, which will give a continuous light for from 15 to 20 hours on one charge. The light is far brighter, more penetrating, and, if necessary, more concentrated, than that given by oil; moreover, the light can be noiselessly flashed or permanently retained at will. A specially designed switch provides these facilities, and a screw-thread on the bull's-eye supplies the focusing requirements. The strong enamelled case is fitted with a wire-spring belt attachment, with handles if required, and the hinged front is secured by a spring-clip fastener; by this means the accumulator (which is securely fixed by a suitable spring)

can easily be removed from the case, and the few contacts are at once accessible. We are informed that several important police

Fig. 2.—Thomson Electric Police Lamp.

forces have entirely abandoned the oil lamp in favour of the Thomson electric lamp illustrated, and many other police forces have the lamps on test.

E.A.C. Lift-Control Gear.

The Electrical Apparatus Co., Ltd., of Vauxhall Works, South Lambeth Road, S.E., have introduced a new control gear for rope-operated electric lifts. This gear consists primarily of a reversing switch, worked direct by the rope, and a patent combined automatic starter and solenoid main switch. The two pieces of apparatus may conveniently be mounted back-to-back, as shown

Fig. 3.—E.A.C. Lift-Control Gear.

in the illustration herewith, to form a single self-contained unit. The reversing switch has substantial plunger contacts, with coil compression springs and mica insulation. It never makes or breaks the main current, this being done on the automatic starter, which has a special solenoid main switch for this purpose. The main feature of the combined automatic starter and solenoid main switch is the operation by one solenoid of both the quickly-moving main switch and the slowly-moving starter arm.

A New Gem Lamp.

The British Thomson-Houston Co., Ltd., Rugby, have added to their range of Gem lamps a 30-watt lamp of 10 c.p. Three sizes of Gem lamps are now available—viz., 30-watt, 10 c.p.; 45-watt, 16 c.p.; 60-watt, 20 c.p.; and their average lives are 1,000, 1,500, and 800 hours respectively. These lamps are supplied to operate singly on 100 to 130-volt circuits, and in series on 200 to 260-volt circuits. For tramway service they can be used five in series on 500 to 600-volt circuits.

Sevenoaks Lighting.—At the last meeting of the U.D.C. it was decided to take the necessary steps for transferring the Council's Electric Lighting Order to Crompton & Co., Ltd. For the purpose of having a supply available within 12 months, permission is to be given to the company to commence operations at the earliest possible date, subject to their accepting such conditions in the Order as the Council may think fit. The Council is to take no liability in the event of the Order not being transferred.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

7,810. "Apparatus for the utilisation of atmospheric electricity." H. Emens. April 1st.

7,812. "Ignition for internal-combustion engines." J. S. Everard. April 1st.

7,858. "Electrical time switches for advertising and other devices requiring special timing conditions for two or more purposes." J. E. Olvis and H. F. Joel, Jun. April 1st.

7,885. "Electric recording apparatus." W. Whitie and A. E. Langley. April 1st.

7,888. "Relays, microphones, or other sensitive contact devices." P. O. Pedersen. April 1st. (Complete.)

7,889. "Electric apparatus for recording the discharge of materials from wagons." J. Wasgestian. April 1st. (Complete.)

7,903. "Method of regulating the alteration in lines loaded according to the Pupin system for vibrations of various periodicities." F. A. Becker. (Addition to 65, 1911. Convention date, March 31st, 1911, Germany.) April 1st. (Complete.)

7,906. "Automatic switch for working electric relay switches and devices." A. E. Carter. April 2nd.

7,910. "Supports of overhead electric telephone and telegraph wires and the like." G. Bull. April 2nd.

7,928. "Clutches operated by electromagnetic coils." G. Richards. April 2nd.

7,949. "Receivers of telephones." D. Evans. April 2nd.

7,959. "Device for ensuring that power handle on controllers of electrically-driven vehicles pause at each notch." J. T. Keenan and E. J. Forster. April 2nd.

7,964. "Electric lamps for vehicles." E. R. Ryman. April 2nd.

7,972. "Electric insulators." A. R. Muller. April 2nd.

7,977. "Process for the manufacture of incandescent metallic filaments." R. Jahoda and Elektrische Glühlampenfabrik "Watt" vorm Scharf, Potz & Latzko (Convention date, September 30th, 1911, Austria.) April 2nd. (Complete.)

7,993. "Electrically propelled motor-cars." Allmanna Svenska Elektriska Aktie-Bolaget. (Convention date, April 12th, 1911, Sweden.) April 2nd. (Complete.)

7,996. "Gripping and shearing grapnel for raising submarine telegraph cables." W. Hensman. April 2nd.

7,999. "Manufacture of electric accumulator electrodes and means for use therein." R. Pape. April 2nd. (Complete.)

8,017. "Unipolar, non-polar or homopolar dynamo." P. Haynes. April 3rd.

8,039. "Arrangement for indicating the interruption of a circuit in electric lighting installations on motor-cars or like vehicles." C. A. Vandervell and A. H. Midgley. April 3rd. (Complete.)

8,040. "Dynamo electric machines." C. A. Vandervell and A. H. Midgley. April 3rd.

8,050. "Thermoelectric heating and cooling body." E. Altenkirch and G. Gehlhoff. April 3rd.

8,058. "Electric incandescent lamps with bipartite bulb." P. Weisse. (Convention date, April 6th, 1911, Germany.) April 3rd. (Complete.)

8,063. "Voltage regulators for electric generators." A. H. Olmsted. (Addition to 28,747, 1911.) April 3rd.

8,070. "Regulation of the frequency produced by polyphase induction generators." Siemens Schuckertwerke G.m.b.H. (Convention date, April 3rd, 1911, Germany.) April 3rd. (Complete.)

8,075. "Electricity meters." Isaria Zahlerwerke Akt.-Ges. (Convention date, April 3rd, 1911, Germany.) April 3rd. (Complete.)

8,086. "Electric lamps." P. C. Hewitt. (Convention date, April 8th, 1911, United States.) April 3rd. (Complete.)

8,087. "Electric lighting apparatus." F. Dussaud. (Convention date, April 6th, 1911, France.) April 3rd. (Complete.)

8,088. "Ferro-concrete pole especially for supporting electric conductors." P. Rose and A. Oldenburg. April 3rd. (Complete.)

8,108. "Arrangement for starting and regulating direct-current electric motors." F. Cumont. (Convention date, June 29th, 1911, France.) April 3rd. (Complete.)

8,118. "Telegraph and like cable conductors." W. E. Hitch. April 4th.

8,129. "Shade-holders for electric glow-lamps." G. E. Crowther. April 4th.

8,140. "Electric arc lamps." W. Schaffer and A. Heidmann. April 4th.

8,144. "Process of manufacturing spiral resistances and of mounting same in position within tubular supports for electrical heating apparatus." C. O. Bastian. April 4th.

8,151. "Long-distance telephonic apparatus." P. St. G. Kirke. April 4th.

8,152. "Electro pneumatically operated brakes." W. V. Turner. (Convention date, July 18th, 1911, United States.) April 4th. (Complete.)

8,158. "Controlling arrangements for electric cranes." Siemens Schuckert-Werke G.m.b.H. (Convention date, April 12th, 1911, Germany.) April 4th. (Complete.)

8,183. "Prevention of sparking in the control of electric circuits." W. A. Price. April 4th.

8,193. "Electric furnaces." Jössingfjord Manufacturing Co., A/S. (Convention date, April 4th, 1911, Norway.) April 4th. (Complete.)

8,196. "Improvements in or relating to high-frequency apparatus and also to induction coils." W. Dubilier. April 4th.

8,197. "Method of and apparatus for producing high-tension currents." W. Dubilier. April 4th.

8,206. "Sparking plugs for internal combustion engines." M. Riesz. (Convention date, April 5th, 1911, Hungary.) April 4th. (Complete.)

8,207. "Animated coloured pictures." Fuliomatograph Syndicate, Ltd. O. Fulton, and T. T. Baker. April 4th.

8,222. "Conversion of electrical energy." W. A. Price. April 4th.

8,224. "Electric switches." H. Leitner. April 4th.

8,226. "Electricity motors." Isaria Zahlerwerke Akt.-ges. (Convention date, April 7th, 1911, Germany.) April 4th. (Complete.)

8,234. "Electric arc lamps." A. Coilvi-Webb, J. D. White, and R. C. A Reinecke. April 4th.

8,240. "Electric arc lamps." J. Wetter. (Ges. für Maschinen-und Metall-Industrie m.b.H., Germany.) April 4th. (Complete.)

8,242. "Electric arc lamps." F. M. Lewis. April 4th.

8,250. "Osmo regulator apparatus for regulating the degree of hardness of Röntgen ray tubes." C. Regaud. (Convention date, April 24th, 1911, Germany.) April 4th. (Complete.)

8,268. "System for transmitting and recording orders, signals and the like by electrical and mechanical means." F. Croft and H. Swaly. April 4th.

8,278. "Means for and method of changing the frequency of alternating currents." A. M. Taylor. (Addition to No. 8,863, April 10th, 1911.) April 6th.

8,285. "Electric cooker." W. H. Scott. April 6th.